COHORT DIFFERENCES IN DEPENDENCY IN ACTIVITIES OF DAILY LIVING, SELF-PERCEIVED HEALTH AND GP CONTACT IN OLDER PEOPLE OVER A SEVEN-YEAR TIMESPAN

Thesis submitted for the degree of
Doctor of Philosophy
at the University of Leicester

by

Nicola Spiers BSc, MSc (Leicester)
Department of Epidemiology and Public Health
University of Leicester

September 1999

COHORT DIFFERENCES IN DEPENDENCY IN ACTIVITIES OF DAILY LIVING, SELF-PERCEIVED HEALTH AND GP CONTACT IN OLDER PEOPLE OVER A SEVEN-YEAR TIMESPAN

NICOLA SPIERS

ABSTRACT

Total populations aged 75 years an over, drawn from the age-sex register of the General Practice for Melton Mowbray in 1981 and 1988, were surveyed on health and sociodemographics by trained fieldworkers. For this study, participants were subdivided into seven year birth cohorts, born 1885-1891, 1892-1898, 1899-1905 and 1906-1912. Age-cohort and age-period logistic regression models were fitted to quantify trends in dependency (defined by human or technological help in at least one of: mobility about the home; getting in and out of bed; getting in and out of a chair; dressing and eating), in self-perceived health defined by response to the question "For your age, in general, would you say that your health was good, fair or poor?", and in self-reported GP contact in the home or surgery in the past month. Five-year survival and predictors of GP contact were also modelled.

With more than 90% response, numbers interviewed at home were 1124 in 1981 and 1500 in 1988. Prevalence of dependency in the newer cohorts was slightly reduced compared to earlier cohorts surveyed at comparable age, but perceptions of health were *less* favourable in the newer cohorts, this difference being statistically significant for women. Less than good self-perceived health was confirmed as a predictor of five-year mortality in people aged 75-81 years, and an independent predictor of GP contact. For men, each succeeding cohort had higher rates of GP contact, whilst rates were stable for women. Associations of self-perceived health with GP contact were strongest for men aged 75-81 years in 1988, these men also having higher risk of contact and worse 5-year survival compared to men aged 75-81 years in 1981.

Sustainability and generalisability of the trend in self-perceived health requires confirmation, and there are competing explanations, but results suggest that demand for primary care may exceed projections from demographics, at least for men.

ACKNOWLEDGEMENTS

Sincere thanks to the staff and patients of Latham House Medical Practice, without whom this work would not have been possible. I am more than grateful to Carol Jagger for wise and cheerful supervision throughout, to Jo Barker for typographical work, and to Mark Hibbett, for assistance with the figures.

Special thanks to Paul and Andrew Spiers, for their patience and support.

This thesis is dedicated to my parents.

LIST OF TABLES

Chapter 1

Table 1.1: The population of England and Wales aged 75 years and over: percentage and absolute size, 1961-2021

Table 1.2: Percentage of respondents unable to perform at least one ADL without help, by age group: GHS 1980, 1985 and 1991

Chapter 2

Table 2.1: Standard cohort table showing percentage of participants rating their health as either excellent or good, by survey year and age group, from the health interview survey

Chapter 3

Table 3.1: Sex-ratios: Melton District and Great Britain, 1981 and 1991

Table 3.2: Distribution of socioeconomic status: Melton Mowbray and Great Britain, 1991

Table 3.3: Population surveyed

Table 3.4: Numbers identified and interviewed in 1981 and 1988 surveys by sex, birth cohort, age when survey population drawn and place of residence at interview

Table 3.5: Probability of survival at yearly intervals from interview by sex, age group and year of survey

Table 3.6: Demographic characteristics of the subjects interviewed in their own homes

Chapter 4

Table 4.1: Categories of dependency in physical activities amongst older people interviewed at home: percentage (numbers in parenthesis)

Table 4.2: Health characteristics of the study population by gender and survey

Table 4.3: Hierarchy of basic ADL by severity of disability in community-based studies of older populations

Table 4.4: Coding details for measures included in the cohort analysis

Table 4.5: Proportion (%) dependent in ADL by sex, age (midpoint of age group), cohort (defined by birth year) and year of survey, respondents interviewed at home

Table 4.6: Estimated odds ratios of dependency in ADL under age-period and cohort models for men and women separately, 95% confidence intervals (CI) in parentheses

Table 4.7: Estimated odds ratios of dependence in ADL using four-item scale: age-period and age-cohort models for men and women separately, 95% confidence intervals (CI) in parentheses

Table 4.8: Proportion (%) dependent in bathing by sex, age (midpoint of age group), cohort (defined by birth year) and year of survey, respondents interviewed at home

Table 4.9: Estimated odds ratios of dependence in bathing: age-period and age-cohort models for men and women separately, 95% confidence intervals (CI) in parentheses

Table 4.10: Proportion (%) incontinent in at least one of urine and faeces, by sex, age (midpoint of age group), cohort (defined by birth year) and year of survey, respondents interviewed at home

Chapter 5

Table 5.1: Two-factor models fitted for male and female populations

Table 5.2: Proportion (%) in less than good self-perceived health by sex, age (midpoint of age group), cohort (defined by birth year) and year of survey

Table 5.3: Estimated odds ratios of less than good self-perceived health under age-period and cohort models for men and women separately, 95% confidence intervals (CI) in parentheses; persons interviewed at home

Table 5.4: Proportion (%) with less than good self-perceived health by sex, age (midpoint of age group), cohort (defined by birth year), ADL dependency and year of survey

Table 5.5: Estimated odds ratios of less than good self-perceived health adjusting for independence in ADLs under age-period and cohort models for men and women separately, 95% confidence intervals (CI) in parentheses; community-based population

Table 5.6: Five-year survival: relative risks of death by sociodemographic and health status; men resident in the community in 1981 and 1988

Table 5.7: Five-year survival: relative risks of death by sociodemographic and health status; women resident in the community in 1981 and 1988

Table 5.8: Predicted mortality hazard ratio for less than good self-perceived health by age group from final model; participants interviewed at home

Table 5.9: Self-perceived health by survey; survivors interviewed at home in both 1981 and 1988

Chapter 6

Table 6.1: Published studies reporting GP use in UK population aged over 65 years

Table 6.2: Subgroups for logistic regression analysis, with numbers included

Table 6.3: Percentage of men with GP contact in the past month, by age, cohort and self-perceived health

Table 6.4: Percentage of men with GP contact in the past month, by age, cohort and ADL dependency

Table 6.5: Odds ratios for GP contact by self-perceived health and ADL dependency, men aged 75-81 years and 82-88 years, surveyed in 1981

Table 6.6: Odds ratios for GP contact by self-perceived health and ADL dependency, men aged 75-81 years and 82-88 years, surveyed in 1988

Table 6.7: Percentage of women with GP contact in the past month, by age, cohort and self-perceived health

Table 6.8: Percentage of women with GP contact in the past month, by age, cohort and ADL dependency

Table 6.9: Odds ratios for GP contact by self-perceived health and ADL dependency, women aged 75-81 years and 82-88 years, surveyed in 1981

Table 6.10: Odds ratios for GP contact by self-perceived health and ADL dependency, women aged 75-81 years and 82-88 years, surveyed in 1988

Chapter 7

Table 7.1 Proportion (%) of men and women seen by a GP in past month by age (midpoint of age group), cohort (defined by birth year) and year of survey

Table 7.2 Estimated odds ratios of contact in the past month, under age-period and cohort models for women, with 95% confidence intervals (CI) in parentheses

Table 7.3: Proportion (%) of women seen in past month by age (midpoint of age group), cohort (defined by birth year), self-perceived health and year of survey

Table 7.4: Estimated odds ratios of contact with a GP in the past month, under age-cohort and age-period models with self-perceived health included as a covariate for women, with 95% confidence intervals (CI) in parentheses

Table 7.5: Estimated odds ratios of contact with a GP in the past month, under age-cohort and age-period models with ADL dependency included as a covariate for women, with 95% confidence intervals (CI) in parentheses

Table 7.6: Estimated odds ratios of contact in the past month, under age-period and cohort models for men, with 95% confidence intervals (CI) in parentheses

Table 7.7: Proportion (%) of men seen in past month by age (midpoint of age group), cohort (defined by birth year), self-perceived health and year of survey

Table 7.8: Estimated odds ratios of contact in the past month, adjusting for self-perceived health under age-period and cohort models for men, with 95% confidence intervals (CI) in parentheses

Table 7.9: Estimated odds ratios of contact in the past month, adjusting for ADL dependency under age-period and cohort models for men, with 95% confidence intervals (CI) in parentheses

Table 7.10: Proportion (%) of men aged 75 years and over in good self-perceived health seen by a GP in the past month, by age

Chapter 8

Table 8.1: Factors suggested as accounting for less than good self-perceived health

Table 8.2: Number and proportion of patients with GP contact in the past month, 1988; actual figures compared to projections based on 1981 rates and population age structure

Table 8.3: Sex-ratio for self-reported contact with a GP in the past month

LIST OF FIGURES

Chapter 1

Figure 1.1: Changes in the age distribution of the population; England and Wales, 1841-1996

Figure 1.2: General fertility rate, England and Wales 1870-1920

Figure 1.3: All cause mortality at ages 0-44 years, by age and sex: England, Scotland and Wales, 1841-1994

Figure 1.4: All cause mortality at age 45 years and over, by age and sex: England, Scotland and Wales, 1841-1994

Figure 1.5: Actual and projected age distribution, United Kingdom, 1991-2064

Chapter 2

Figure 2.1: Mortality rates for cancer of the lungs, England and Wales 1926-1954: males

Figure 2.2: Interrelationship between cohort differences, age-cohort profiles and cross-sectional age curves

Figure 2.3: The Lexis diagram

Figure 2.4: The age stratification perspective

Chapter 3

Figure 3.1: Melton Mowbray

Figure 3.2: Age-sex distribution of males in Melton Mowbray District and Great Britain, 1981

Figure 3.3: Age-sex distribution of females in Melton Mowbray District and Great Britain, 1981

Figure 3.4: Percentage of population aged over 75 years: Melton District and Great Britain, 1981 and 1991

Chapter 4

Figure 4.1: Percentage of women dependent in ADL and number surveyed, by age (midpoint of age group) and cohort; community-based population

Figure 4.2: Percentage of men dependent in ADL and number surveyed, by age (midpoint of age group) and cohort; community-based population

Figure 4.3: Percentage of women dependent in ADL and number surveyed, by age (midpoint of age group) and cohort; 1981 community-based population

Figure 4.4: Percentage of women dependent in ADL and number surveyed, by age (midpoint of age group) and cohort; community-based population; mobility excluded from the list of ADL used to define impairment

Figure 4.5: Percentage of men dependent in bathing and number surveyed, by age (midpoint of age group) and cohort; community-based population

Chapter 5

Figure 5.1: Predicted logodds of less than good self-perceived health, by age, cohort and ADL dependency from an additive model for women interviewed at home

Figure 5.2: Less than good self-perceived health and ADL dependency: prevalence by sex and survey

Figure 5.3: Percentage of women with less than good self-perceived health and number surveyed, by age (midpoint of age group) and cohort: community-based population

Figure 5.4: Percentage of men with less than good self-perceived health and number surveyed, by age (midpoint of age group) and cohort: community-based population

Figure 5.5: Percentage of women with less than good self-perceived health, by age (midpoint of age group), ADL dependency and cohort: community-based population

Figure 5.6: Percentage of men with less than good self-perceived health, by age (midpoint of age group), ADL dependency and cohort: community-based population

Figure 5.7: Percentage of the US population aged over 55 with fair or poor self-perceived health, from the Health Interview Survey

Chapter 6

Figure 6.1: Behavioural model of use of health services

Figure 6.2: Percentage of men reporting GP contact by survey

Figure 6.3: Percentage of women reporting GP contact by survey

Chapter 7

Figure 7.1: Percentage of women seen by a GP in the past month and number surveyed, by age (midpoint of age group) and cohort; community-based population

Figure 7.2: Percentage of women seen by a GP in the past month and number surveyed, by age (midpoint of age group), cohort and self-perceived health; community-based population

Figure 7.3: Percentage of women seen by a GP in the past month and number surveyed, by age (midpoint of age group), cohort and ADL dependency; community-based population

Figure 7.4: Percentage seen by a GP in the past month by age; women interviewed at home and independent in ADL, 1981 and 1988

Figure 7.5: Percentage seen by a GP in the past month, by age; women dependent in ADL and interviewed at home, 1981 and 1988

Figure 7.6: Estimated proportion seen by a GP in the past month, by age and self-perceived health: women independent in ADL

Figure 7.7: Percentage of men seen by a GP in the past month, by age (midpoint of age group) and cohort

Figure 7.8: Percentage of men seen by a GP in the past month by age (midpoint of age group), cohort and self-perceived health

Figure 7.9: Percentage of women seen by a GP in the past year and number surveyed, by age (midpoint of age group) and cohort

Figure 7.10: Trends in consultation with an NHS GP in the 14 days before interview; GHS 1981-1991

LIST OF APPENDICES

Chapter 2

Appendix 2A: Generation of hypothetical data for Figure 2.2 from age-cohort and age-period models

Appendix 2B: Non-identifiability of the three-factor age-period-cohort model

Chapter 4

Appendix 4A: Item wording for ADL dependency: 1981
(Question 30 reproduced in full from schedule for 1981 population survey)

Appendix 4B: Item wording for ADL dependency: 1988

Appendix 4C: Standardised coefficients from the principal components analysis for ADL dependency; participants interviewed at home 1981 (n=1123) and 1988 (n=1495)

Appendix 4D: Hierarchical properties of the ADL scale

Table 4Di) Scalability coefficients for dependency scales by survey

Table 4Dii) Scalability coefficients for dependency scales by gender and survey

Table 4Diii) Scalability coefficients for dependency scales by type of housing and survey

Table 4Div) Scalability coefficients for dependency scales by gender and living arrangements

Figure 4Di) Most frequent combinations of ADL dependency, with percentages; participants interviewed at home who were dependent in at least one ADL, 1981

Figure 4Dii) Most frequent combinations of ADL dependency, with percentages; participants interviewed at home who were dependent in at least one ADL, 1988

Appendix 4E: Calculation of odds ratios and 95% confidence intervals

Appendix 4F: Estimated odds ratios of dependency in Activities of Daily Living, using four-item scale; age-cohort and age-period models for men and women separately, 95% confidence intervals (CI) in parentheses

CONTENTS

1. INTRODUCTION 1

1.1 Demographic context and broad aims of the study ... 1

1.2 The elderly population - size and projections ... 6

1.3 The elderly population - health status and disability prevalence ... 7

1.4 Review of trends in self-perceived health of the elderly population ... 12

1.5 Uniqueness of data source and aims of the thesis ... 13

1.6 Summary ... 15

2. COHORT ANALYSIS 24

2.1 Historical development ... 24

2.2 The identification problem ... 26

2.3 Age-stratification theory ... 32

2.4 Cohort analysis in gerontology ... 35

2.5 Approach adopted in the present study ... 38

2.6 Summary ... 40

3. THE STUDY POPULATION 46

3.1 Melton Mowbray ... 46

3.2 The study cohorts ... 47

3.3 Five-year survival and sociodemographic characteristics ... 49

3.4 Summary ... 50

4. TRENDS IN ADL DEPENDENCY AND SELF-PERCEIVED HEALTH 62

4.1 Measurement of ADL dependency and definition of community-based population ... 62

4.2 Psychometric properties of the ADL scale and implications for the analysis of trends ... 64

4.3 Cohort analysis: methodology ... 68

4.4 Prevalence of dependency in activities of daily living ... 69

4.5 What can be concluded about trends in ADL dependency? ... 72

4.6 Summary ... 75

5. TRENDS IN SELF-PERCEIVED HEALTH **91**
5.1 Methodology 94
5.2 Prevalence of less than good self-perceived health 95
5.3 Interrelationship between less than good self-perceived health and ADL dependency 97
5.4 Self-perceived health and survival 98
5.5 Ageing and longitudinal change in self-perceived health 101
5.6 Robustness of the conclusions 101
5.7 Trend in self-perceived health: cohort or period effect? 104
5.8 Summary 108

6. SELF-PERCEIVED HEALTH AND ADL DEPENDENCY AS PREDICTORS OF GENERAL PRACTITIONER CONTACT **126**
6.1 Are increased levels of less than good self-perceived health associated with increased use of health services? 126
6.2 Review of evidence on predictors of GP contact 126
6.3 Measures and summary of rates of contact 130
6.4 Predictors of contact with a GP in the past month - strategy for logistic regression 131
6.5 Predictors of contact with a GP in the past month - men 132
6.6 Predictors of contact with a GP in the past month - women 134
6.7 Conclusions and discussion 135
6.8 Summary 137

7. TRENDS IN GP CONTACT **152**
7.1 Methods 152
7.2 Women: trends in rates of contact with a GP 153
7.3 Women: rates of contact with a GP by age 154
7.4 Men: rates of contact with a GP by age, cohort and survey 155
7.5 Men: rates of contact with a GP by self-perceived health 156
7.6 Men: rates of contact with a GP by age 157
7.7 Discussion and conclusions 158
7.8 Summary 161

8. DISCUSSION **182**

8.1 Trends in ADL dependency, self-perceived health and GP contact 182

8.2 Limitations of the study 183

8.3 Accounting for trends in ADL dependency, self-perceived health and GP contact: physical health 187

8.4 Accounting for trends in ADL dependency, self-perceived health and GP contact: health perceptions and mental health 190

8.5 Implications for policy and further research 192

8.6 Summary 195

9. CONCLUSIONS **199**

BIBLIOGRAPHY **200**

APPENDICES **216**

1. INTRODUCTION

1.1 Demographic context and broad aims of the study

To plan and develop health services to meet future needs in the older population, it is necessary to project both the size and health status of future populations. A natural starting point is the population projections published in the UK by the Government Actuary. Effects of rates of fertility and reduced infant mortality in the early years of the 20th century on population size and age structure are known, so that increase in the absolute and relative size of the population aged 75 years and over is predictable (Craig, 1987). This increase in the older population may be viewed as a consequence of the demographic transition, whereby developing societies move from a scenario of high fertility and high mortality from communicable diseases at young ages, through a period of fertility and mortality decline, to an age of low and stable mortality, accompanied by relatively low levels of fertility. The result is a shift in population age structure towards middle-aged and older age groups, such as that experienced over the 20th century by the population of England and Wales, (Figure 1.1). Accompanying the demographic transition is a shift in age and cause of death, defined as the epidemiological transition (Omran, 1971; 1983). Declining death rates from infectious diseases in young age groups are accompanied by an increase in numbers of deaths from chronic degenerative diseases in middle and old age.

In terms of fertility and mortality rates, the course of the demographic and epidemiological transitions in developed countries such as the UK is now largely mapped out, with potential for improvement in mortality at young ages almost exhausted. The implications of fertility rates and early life mortality for the size of the elderly population are known, and result in projections of an elderly population increasing both in absolute size and as a proportion of the population. However variation in projections due to uncertainty about future mortality rates at high ages may be quite marked (Murphy, 1995).

Relative to population projections, forecasts of health status and demand for healthcare of the older population rely upon incomplete data and are much more uncertain. Straightforward application of age-specific morbidity rates of today to the projected population assumes that lifetime influences upon health of the cohorts who will form the elderly of tomorrow are adequately represented by observation of previous cohorts. This assumption may be questioned since selection by mortality, infection rates in infancy, incidence of common conditions, lifestyle factors, and experience of health care, are all factors which have implications for health in later life and which may vary substantially across cohorts.

Population projections provide reasonably reliable estimates of the size of the older population of the future, but health status and demand for healthcare of this population are much more uncertain. Straightforward application of age-specific morbidity rates of today to the projected population assumes that lifetime influences upon health of the cohorts who will form the elderly of tomorrow are adequately represented by observation of previous cohorts. This assumption may be questioned since selection by mortality, infection rates in infancy, incidence of common conditions, lifestyle factors, and experience of health care, are all factors which have implications for health in later life and which may vary substantially across cohorts.

The argument that newer cohorts cannot simply repeat the health experience of previous cohorts, not least because they will be much more numerous at the oldest ages, seems inescapable. An early and well-known challenge to the assumption of immutable ageing across cohorts was the compression of morbidity hypothesis (Fries, 1980). Fries' hypothesis was that advances in living standards and medical technology would result in postponement of the onset of disability and disease for the majority of the population, so that serious ill-health would be compressed into a short period at the end of life. The opposing hypothesis is that of morbidity expansion (Gruenberg, 1977; Kramer 1980) which postulates that postponement of mortality will be at the expense of more time spent in a state of ill-health.

Subsequent research has recognised that the compression/expansion dualism is insufficient to describe the complexity of mechanisms underlying trends in chronic morbidity. Manton (1982) proposed a theory of 'dynamic equilibrium', with expansion due to slowed progression of chronic diseases, so that increased prevalence of disability is accompanied by a shift towards milder disabilities. He has since demonstrated that trends in prevalence and incidence may not coincide, due to systematic variations in survival (Manton, 1988). Olshansky et al (1991) describe two distinct mechanisms for morbidity expansion. First, prolonged survival of people with chronic disabling conditions, due to advances in medical technology, and second, a shift in the cause of disability from fatal to non-fatal diseases. Myers and Lamb (1993) have theorised implications of the epidemiological transition for changes in prevalence, distribution and nature of disability, suggesting that the transition will involve a shift towards higher prevalence amongst women than men, and that socioeconomic differentials will increase.

Theories of morbidity expansion have received some empirical support from calculations of Healthy Expectancy; in particular disability-free life expectancy (DFLE). DFLE is calculated by applying age-specific rates of mortality and disability incidence (or prevalence) to a notional population, in order to quantify the implications of these rates for the average length of time lived in disabled and non-disabled states. Calculations based upon prevalence of limiting longstanding illness in England and Wales (Bone et al, 1995) show gains in disability-free life expectancy lagging behind improvements in life expectancy. A similar pattern is evident in calculations based on the Longitudinal Study of Aging in the US (LSOA) by Crimmins, Saito and Ingegeri (1989). However, in a comparison of these results with time series for five other developed nations, the overall pattern seems to be of disability-free life expectancy increasing in parallel with total life expectancy (Robine, 1994a).

Conclusions on trends must be cautious, however, because most time series with comparable measures have only two points. In the British General Household Survey (GHS), which has calculations repeated in six years between 1976 and 1992, fluctuations in the expectancies are almost as large as any trend, reflecting irregularities in the times series for limiting longstanding illness which is used to calculate the health expectancies (Bebbington, 1991). Both direction and magnitude of trends may depend upon the threshold adopted for disability, and recent results from France (Robine, 1994b) provide evidence of compression at milder levels of disability. In his paper, Robine uses a four-level classification of disability to compare Healthy Life Expectancy times series in seven developed nations.

As disability measures are refined, and as the time series develop, Healthy Life Expectancies have potential to track broad population movements in morbidity. However, most health expectancy calculations are prevalence-based, using Sullivan's method (Sullivan, 1971), and so tend to be conservative in detecting disability trends. Moreover, the calculations are period-based, using schedules of mortality and morbidity rates observed in a single period of observation, and hence only of use for projection if an assumption of invariant age-specific rates across cohorts is upheld. Cohort-based health expectancies circumvent this difficulty, but as with cohort-based life expectancy, the problem remains that the calculation cannot be completed until almost all in the relevant cohort are deceased. For this reason, with few exceptions, period-based life expectancy and health expectancy are the norm in the literature. However, if mechanisms underlying changing schedules of mortality and morbidity are to be well-understood, and if health expectancy methods are to be used to generate projections, methods for incorporating intercohort differences in mortality and disease incidence must be found. This involves modelling cohort differences in mortality and morbidity schedules, in order to feed the results into health expectancy calculations. (Heathcote and McDermid, 1994).

A clear-cut example of the relevance of cohort differences for projection is in relation to dental health, where there has been a considerable increase across cohorts in the age-specific proportion of the population retaining their own teeth. In 1991, 57% of adults aged 65-74 in Great Britain retained some of their own teeth, compared to only 40% of those of comparable age in 1983 (GHS, 1991) and substantial cohort effects, with increased rates of contact with a dentist, have also been reported in the US (Wolinsky and Arnold, 1989). Information on trends from past and current cohorts may be combined with theory relating to mechanisms such as improved general health, diet, fluoridation and improved dental care to inform predictions for the size of the edentulous population and demand for dental care in the future.

The example of cohort differences in dental care illustrates how projections of need may fail if they do not take account of the prior experience of cohorts for whom the projection is made. In order to plan health care, information is required both on the health status of cohorts as they age, and also on patterns of determinants of health service use, and how these vary across cohorts. The extent to which this information is available for cohorts approaching old age in the UK is quite limited, and will be reviewed later in this chapter.

The studies of the population of Melton Mowbray, Leicestershire were conceived as a population laboratory, recognising the need to enumerate incidence rates with a denominator as close as possible to the entire population. The objective was to estimate incidence and prevalence of chronic conditions, together with need for services in a total elderly population, observed repeatedly in their own homes (Clarke, 1995). The nature of this group of studies, with repeated cross-sections of the total populations in 1981 and 1988, means that the health status of cohorts born around the turn of the 20th century can be tracked as they age beyond 75 years. This thesis concentrates upon secondary analysis of data from these linked cross-sectional studies, and interrelationships between trends in health and health service use across the cohorts. The broad aim is to investigate the extent of cohort differences in disability and perceived health, and to assess the relevance of these differences for projections of health care needs in the elderly population.

In the remaining sections of this chapter, the context for the study will be examined, with an account of the changing age structure of the population of England and Wales. This will be followed by a review of evidence relating to trends in disability and self-perceived health in the elderly population, both in the UK and internationally. Against this background, the final section will set out in more detail the aims and objectives of the study.

1.2 The elderly population - size and projections

This thesis is primarily concerned with the cohorts born from 1882-1916, at a time when the epidemiological transition was gaining pace. In England and Wales, decline in general fertility rate had begun by the 1880s (Figure 1.2), and was only partly offset by declining child mortality in the early years of the 20th century (Craig, 1987). Whilst the fertility rate declined all but uniformly until the 1940s, the number of live births continued to increase until 1908, reflecting fluctuation in the size of the parent cohort. However differences in the size of the cohorts at birth are less significant than trends due to mortality decline.

Mortality for children aged 1-14 years declined throughout the relevant period, with the exception of a minor peak during World War I, but is dwarfed in effect by infant mortality (Figure 1.3). Infant mortality remained more or less constant at around 145 per 1000 until 1901, but fell quite rapidly thereafter, so that the rate in 1909 was 110 per thousand in England and Wales (OPCS series DH1, no 25). All of the study cohorts suffered increased mortality due to the influenza pandemic of 1918-1919, but mortality due to World War I was concentrated in the cohorts aged 16-40 years, and so resulted in a deficit of men in the cohorts born in the late 19th century, with this effect petering out in the cohorts born in 1900 and after. Cohorts born during the early part of the 20th century suffered mortality in World War II, but to a lesser extent. There were 730,000 deaths amongst British Forces in 1914-1918, compared with 274,000 in 1939-1945, a ratio of 2.6:1. (Coleman and Salt, 1992).

With the exception of period effects related to the World Wars, the cohorts born from 1892-1912 have lived through an era of mortality declines at all ages, so that in general, each cohort has experienced lower mortality at every age than its precursors. (Figure 1.3), although in young adulthood, and in the male population generally, these mortality gains have been small. The lesser gain in the male population reflects shallower mortality declines which have been attributed to countervailing effects of cigarette smoking (Grundy, 1997). Receding selection by mortality, together with the effects of increased numbers of births through the 1890s and early 1900s, has resulted in increased size of the population aged over 75 years, both absolutely and as a proportion of the total population (Table 1.1). Over the 1980s, the population aged over 75 years both increased in size, and aged, with the proportion aged over 85 years within this age group increasing from 18.2% in 1981 to 21.6% in 1988.

A steady increase in the proportion of the total population aged over 75 years has taken place throughout the 20th century, and is projected to continue for the first half of the 21st century (Figure 1.4). Medium-term projections of the size of the elderly population are uncertain because of the need to project mortality rates at the highest ages. The question of whether mortality declines at the highest ages will be maintained is subject to some controversy (Manton, Stallard and Tolley, 1991; Thatcher, 1992). The Government Actuary's routine 1994-based projections include variant projections for regimes of high and low mortality. The high mortality variant makes the rather pessimistic assumption that the potential for mortality declines will be exhausted by 2032, whilst the low mortality projection assumes that mortality gains will stabilise at 1% per year. Although these are widely varying scenarios, effect upon medium-term population projections of adopting these varying assumptions is not large. Comparing 1992 and 1994-based projections, differences are greater for the population aged 75 years and over than for other age groups, with the exception of the under 16 year-olds, but the differences between projections based upon different mortality scenarios are still less than 5% of population size, for projections up to 20 years ahead.

Good quality data, together with almost complete knowledge of the processes involved, results in reasonably firm projections of numbers in the elderly population in the short and medium term. However there is some way to go before the same can be said with regard to projections of health status.

1.3 The elderly population - health status and disability prevalence

Projections of health status depend upon definitions and measures of population health. Lack of agreement over how to assess the health status of elderly populations has resulted in use of a range of health status measures in epidemiological surveys of elderly populations. Verbrugge (1990) identifies a typology of measures based upon biomedical, functional and psychological models of health. The present study concentrates upon health status as measured by ability to function (dependency in Activities of Daily Living) and self-perceived health relative to others of the same age. Biomedical measures of health were not elicited in the Melton Mowbray surveys, because of the difficulty of obtaining accurate self-reports of a range of conditions in an elderly population.

Dependency in Activities of Daily Living (ADL) and self-perceived health are the two most consistent predictors of health service use across a range of health services and populations, at least in North American studies (Wan, 1989). Self-reported ADL dependency is a predictor of decline in function (Jagger, Spiers and Clarke, 1993; Palmore, Nowlin and Wang, 1985) and mortality (Bernard et al, 1997; Grant, Piotrowski and Chappell, 1995; Dighe, Aparasu and Rappaport, 1997) as is self-perceived health (van Doorn and Kasl, 1998; Idler and Benyamini, 1997). Because both ADL dependency and self-perceived health involve self-reported health, there are particular issues relating to validity and reliability of the measures, and these will be discussed later in this thesis.

Longitudinal studies in the UK have revealed patterns of, in the main increasing, functional impairment as cohorts age. For example, in a 2.5-3 year follow-up of people aged 65-84 years living at home in Hackney and Essex, deterioration in functional status was reported in 14% of those resurveyed, compared with improvement in 5% (Bowling and Grundy, 1997). In the population aged 85 years and over the corresponding rates were 34% and 3%, indicating increased risk of deterioration with age. Rather different results for the transition risk in five-year survivors of the population aged 75 years and over, with rates of improvement of 15% and decline of 17% were observed in the first Melton Mowbray population survey (Jagger, Spiers and Clarke, 1993). This probably reflects the longer follow-up period, with the intervening effects of high mortality amongst the dependent population. Risk of improvement or deterioration also depends to some extent upon the sensitivity of definition adopted for dependency. However, a pattern of increased risk of impairment with age, together with a smaller but non-negligible risk of improvement is confirmed in US studies (Strawbridge et al, 1992; Branch et al, 1984; Beckett et al, 1996). Risks of decline in function are found to increase with age, and to be greater amongst women (Strawbridge et al, 1992; Beckett et al, 1996).

Trajectories of functional decline with age are heterogeneous, and have been shown to be non-linear in analyses of two panel studies in the US; the Longitudinal Retirement History Study (LHRS; Maddox and Clark, 1992), and the Established Populations for Epidemiological Studies of the Elderly (EPESE studies; Beckett et al, 1996). These studies are unique in having repeated assessments of functioning at more than three occasions. Whilst in the EPESE studies, the rate of mean decline in function increased with age, the opposite was apparently the case in the LRHS. This difference in conclusions may be accounted for by the design of the studies. Whilst the EPESE studies included a population aged over 65 years, and adjusted for effects of age, the LRHS followed up a cohort aged 58-63 years for ten years. Furthermore, a slowing of the rate of decline at higher ages in the LRHS may result from inclusion of well-being as one of three dimensions of function.

Longitudinal studies typically address change in functional status within one cohort, rather than trends across cohorts. Knowledge about trends in ADL dependency in the UK population across cohorts is confined largely to that available from the General Household Survey (GHS). Bone (1995) reviews data from the GHS of 1980, 1985 and 1991, when supplementary questions were included on ability to perform basic ADL. Dependency was defined using the four ADL of eating, transferring to and from bed, going to the toilet and bathing. Prevalence are reported for dependency in ADL, with independence defined as ability to perform the activity without help from others. The proportion of participants who were unable to perform at least one of the ADL without help is given in Table 1.2. There was no increase in the prevalence of dependency between 1980 and 1991, although there was higher prevalence in 1985. In the older subgroups, a noticeable decline in the prevalence of dependency is reported. This is supported by corresponding decreases in the oldest age groups in the percentage of people unable to get around the house alone, even on the level, and the percentage unable to get down the road alone. The higher prevalence in 1985 suggest that conclusions about a trend may be sensitive to choice of 1981 as the baseline year.

Results from the US, where availability of largescale cross-sectional and longitudinal datasets has allowed more detailed work, also suggests that apparent trends in dependency should be interpreted with some caution. In a recent comparison of population estimates from the National Long Term Care Study, a reduction is reported in the age-standardised prevalence of impairment in ADL or institutionalisation for the US population aged over 65 years from 19.4% in 1982 to 17.0% in 1994, (Manton, Corder and Stallard, 1997). However, in a similar repeated cross-sectional analysis using the National Health Interview Survey, only a minute decrease in age-adjusted prevalence of ADL impairment between 1982 and 1993 was found, from 7.6% to 7.4% (Crimmins, Saito and Reynolds, 1997). This result is compared with analysis by the same authors of the 1984, 1986, 1988 and 1990 waves of the Longitudinal Supplement on Ageing (LSOA), where an *increase* in prevalence of disability of 1.6 percentage points from 1984 to 1990 is estimated with adjustment for age and sex. Although it might be concluded that the overall picture is one of little change in disability prevalence in the US over the 1980s, the differences in conclusions cannot be ascribed to random sampling error, due to the size of the surveys.

Possible reasons for the divergence in findings include design differences between the surveys (Crimmins, Saito and Reynolds, 1997). For example, the four waves of the LSOA involve follow-up data, with an ageing sample who would be expected to have increased rates of disability. A model which allows for a linear increase in the log odds of disability by age may not be sufficient to fully adjust for this ageing effect, and may account for some of the additional prevalence of disability in the LSOA sample. A similar pattern, with increased prevalence of disability assessed longitudinally is reported by Beckett et al (1996) for the EPESE studies, and attributed to inclusion of people living in institutions in the follow-up, but not at baseline. However, people interviewed in institutions were excluded from the LSOA analysis. A further explanation may be that ageing effects estimated cross-sectionally are dampened by cohort effects. However, this would require lower prevalence of disability in the older cohorts, which runs counter to evidence of decline in prevalence.

The most likely factor accounting for the differences in findings between surveys is differences in the definition and measurement of disability. Both wording and choice of ADL items included in a scale may have a substantial impact upon estimates of disability prevalence (Jette, 1994; Weiner et al, 1990). Successively smaller disabled populations are identified, using difficulty, human or mechanical help, and human help as the threshold for ADL limitation. Difficulties in interpretation arise from lack of conceptual clarity relating to definition and measurement of disability. Lawrence and Jette (1996), suggest that measures of help received capture people's attempts to accommodate to their intrinsic level of disability, and are thus indirect measures, sensitive to environmental and social circumstances. Recent studies have used self-reported difficulty performing ADL as a more direct measure of disability, (Kempen et al, 1996; Dunlop, Hughes and Manheim, 1997; Kempen, Myers and Powell, 1995) but this measure was not available in the first wave of the present study.

With regard to the incidence of disability, evidence from the US suggests a decline in incidence of disability during the 1980s which is consistent with future decline in prevalence, as the prevalence pool is drained through mortality and filled at a reduced rate. Trends in incidence of disability in the UK for the elderly population remain a matter for conjecture, in the absence of panel studies with sufficient size to produce reliable estimates of transition rates at ages 75 years and over. In the absence of data on trends in incidence, trends in prevalence of disability from cross-sectional data are of considerable interest as the most direct available indicator of future need for long-term and domicilliary care. ADL measures in the present study differ from those in the GHS, most notably in that assistance from an appliance, as well as assistance from another person is used to indicate impairment. Given a different impairment threshold, and known rate of institutionalisation within the population boundaries, the present study offers an opportunity to reassess trends in the population aged over 75 years, and examine robustness of the trend in ADL dependency identified from the GHS.

1.4 Review of trends in self-perceived health of the elderly population

Trends in self-perceived health in the elderly population have been less closely researched than trends in ADL dependency. In the UK, the GHS once again provides the only time series for self-perceived health in the elderly population. Prevalence for the population aged over 75 years in 1988 and 1994 were compared by Askham et al, (1988). There was marginal change between these dates, with the proportion rating their health as less than good increasing from 70% to 71% for women, and from 64% to 65% for men. In a more comprehensive analysis comparing prevalence of good self-perceived health by five year birth cohort, Jarvis (1998) found that prevalence of good self-perceived health declined as cohorts aged, with little or no evidence of cohort or period effects. Amongst women, cohorts born after 1925 had greater proportions with good self-perceived health in middle age than preceding birth cohorts, but at age 75 years and over, cohorts born between 1895 and 1920 produced comparable age-cohort profiles for self-perceived health. In a recent follow-up study of an elderly cohort in Cambridge, UK, Dening et al (1998) report both age and cohort effects, with improved levels of self-perceived health with age in 80-86 year olds followed-up in 1992, compared to the 80-86 year olds in the initial survey in 1986.

Internationally, data on self-perceived health times series are available for the US, the Netherlands and Finland. The most comprehensive analysis is that of Wolinsky (1990) using four waves of the US Health Interview Survey (HIS) between 1972-1973 and 1994-1995. Wolinsky found secular trends varying with age, with improvements over successive cohorts in levels of self-perceived health at ages up to 65 years, but stability or even decline amongst the older age groups. There was noticeably lower prevalence of good self-perceived health in the older respondents in 1984-1985. Idler (1993) also analysed trends in self-perceived health in the US using the EPESE studies, and found a cohort difference, the cohort born in 1900-1905 having significantly worse self-perceived health than those born in 1906-1911 and 1912-1917. The results are not directly comparable with those from the HIS, due to differences in analytical approach. Evidence on trends in self-perceived health from the HIS and EPESE studies will be considered in more detail in Chapter 5.

The pattern of mixed trends at different ages is also apparent in European time series. In Finland, evidence from five comparable cross-sectional studies of the population aged 30-59 suggests a consistent improvement in levels of self-perceived health across cohorts (Heistaro, Vartiainen and Puska, 1996), which appears consistent with findings in the young elderly in the USA. By contrast, in the Netherlands a long term increase has been reported in the proportion of elderly people with fair or poor self-perceived health in the population aged 70-79, comparing surveys of the total population in 1961 and 1993, (Deeg, Kreigsman and van Zonneveld, 1994). However, this trend was reversed amongst participants aged 80-84 years . The time series for Healthy Life Expectancy (the measure of health expectancy based upon self-perceived health), in the Netherlands between 1983 and 1990 exhibits an upwards trend for the men, indicating compression of morbidity, but no such trend is apparent in women (Perenboom, Boshuisen and van de Water, 1993).

Drawing conclusions relating to trends in self-perceived health is difficult because of the relative scarcity of time series and the possibility of systematic cultural variation in responses (Jylhä et al, 1998). There is however a growing body of evidence supporting the predictive validity of self-perceived health with regard to mortality and decline in health, which will be considered in detail in Chapter 5. The present study offers an opportunity to investigate cohort differences in self-perceived health in the UK which have remained largely unexplored.

1.5 Uniqueness of data source and aims of the thesis

Investigations of ageing and population health in the UK have been hampered by scarcity of data. Longitudinal studies of health with adequate numbers of respondents in the oldest groups are rare. Whilst effects of ageing on health have been examined, existing population studies share the limitation that they are cohort centred, with limited potential for investigating whether the observed changes in health with age observed are replicated across cohorts. The Hackney and Essex study (Bowling and Grundy, 1997), Nottingham Longitudinal Study of Ageing (Morgan et al, 1987) and the Cambridge study (Dening et al, 1998) all capture health trends within cohorts, but absence of ageing-in samples at follow-up means that intercohort comparisons are limited. The Health and Lifestyle survey (Cox, Huppert and Whichelow, 1993) also has a follow-up design, and although the age-range is wide, from 65 years upwards, conclusions are limited by relatively small sample size and considerable losses to follow-up. The OPCS longitudinal study (Hattersley and Creeser, 1995) has information on a 1% sample of individuals aged 75 years and over in 1971, 1981 and 1991, but measures are restricted at present to mortality and disease registrations. There are therefore no panel studies in the UK with sufficient numbers of elderly participants to allow for estimation of intercohort differences in transition rates relating to states of disability.

Although restricted to two measurement occasions, the linked cross-sectional design of the Melton Mowbray studies, with inclusion of the new cohort of people aged 75 years and over in 1988 allows both for comparison across succeeding cohorts, interviewed at comparable ages, and also for longitudinal analysis to assess the effect of ageing in survivors. The only comparable UK study with sufficient numbers of older participants to allow for comparison of ageing effects across cohorts is the General Household Survey, with a cross-sectional design allowing for quasi-cohort analysis. Quasi-cohort analysis of ADL dependency and self-perceived health from the GHS has recently become available (Jarvis, 1998) and provides a useful comparator for the present analysis. Data with repeated observations from the same cohort remains scarce for this age group, and the Melton Mowbray population laboratory offers important insights into the health of cohorts born around the turn of the 20th century, as they aged beyond 75 years.

The aim of the present study is to quantify trends in ADL dependency, self-perceived health and contact with a GP in the population aged 75 years and over. Firstly, as participants were followed up after seven years, change in health over time within cohorts may be estimated. Secondly, because there are reasonably large numbers in three seven-year birth cohorts, including a cohort aged 75-81 years entering the survey at the second cross-section, intercohort differences in health status may also be modelled. Comparisons are available between the health of cohorts born 1906-1912 and

1899-1905 at age 75-81 years, and between cohorts born 1899-1905 and 1892-1898 at ages 82-88 years.

The primary objective of the thesis is to investigate cohort differences in health, and assess their relevance for projections of health service use. In order to achieve this objective, the first step is to model the extent of cohort differences in health, represented by ADL dependency and self-perceived health. Having established the degree of difference in self-reported health between successive cohorts, the relevance of these differences for estimation of need for health services is explored by examining interrelationships between cohort differences in health and corresponding differences in levels of GP contact.

The following chapter (Chapter 2) reviews different approaches to cohort-based analysis of longitudinal and linked cross-sectional data, before describing the analytical approach adopted here. Following description of the study cohorts in Chapter 3, Chapters 4 through 7 represent the core of the thesis, presenting cohort analysis of trends in ADL dependency, self-perceived health and GP contact in the linked cross-sectional studies of 1981 and 1988. The thesis concludes with discussion of the generalisability and policy relevance of observed trends in Chapter 8.

1.6 Summary

Trends in survival and general fertility rates in late 19th and 20th Centuries have resulted in an elderly population of increasing size, emphasising the importance of planning health services for this age group. It is unclear whether reduced mortality and improved health conditions experienced by more recent cohorts of elderly people will result in expansion or compression of morbidity, or more complex alternative scenarios mixing expansion and compression, such as those as recently suggested by Olshansky and Manton (Manton, 1982; Olshansky et al, 1991).

The present study uses assessments of population health based upon ADL dependency and self-perceived health to investigate trends in health of the elderly population in the

UK. Results from the US, suggesting a gradual decline in age-specific prevalence of ADL dependency across succeeding cohorts, are supported by more limited data in the UK. In the US, prevalence of less than good self-perceived health increased in the older population over the early 1980s, but longitudinal or repeated cross-sectional data upon self-perceived health of elderly people in the UK is sparse. Predictive validity of self-perceived health with respect to mortality and future health status is confirmed in the majority of studies. The design of the present study, with repeated cross-sections of a total population, including an ageing-in sample at the second survey, offers an unique opportunity to investigate cohort differences in ADL dependency and self-perceived health, and relate these to trends in health service use.

Table 1.1: **The population of England and Wales aged 75 years and over: percentage and absolute size, 1961-2021**

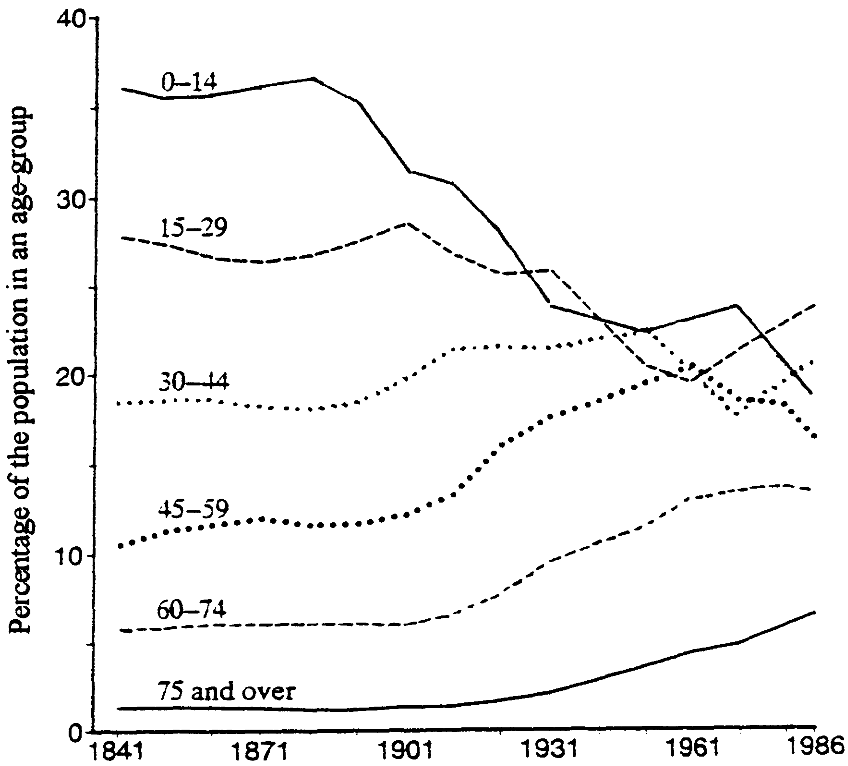
Age group		1961	1971	1981	1991	2001	2011	2021
≥75 years	Number (thousands)	1976	2318	2786	3539	3934	4036	4638
	% of total population	4.3	4.8	5.7	7.1	7.5	7.5	8.5
≥85 years	Number (thousands)	392	535	626	952	1049	1158	1254
	% of total population	0.9	1.1	1.3	1.9	2.0	2.2	2.3

Table 1.2: Percentage of respondents unable to perform at least one ADL[1] without help, by age group: GHS 1980, 1985 and 1991

Age in years	1980	1985	1991
75-79	29	31	26
80-84	47	50	43
85+	72	76	68
All 75+	41	43	38

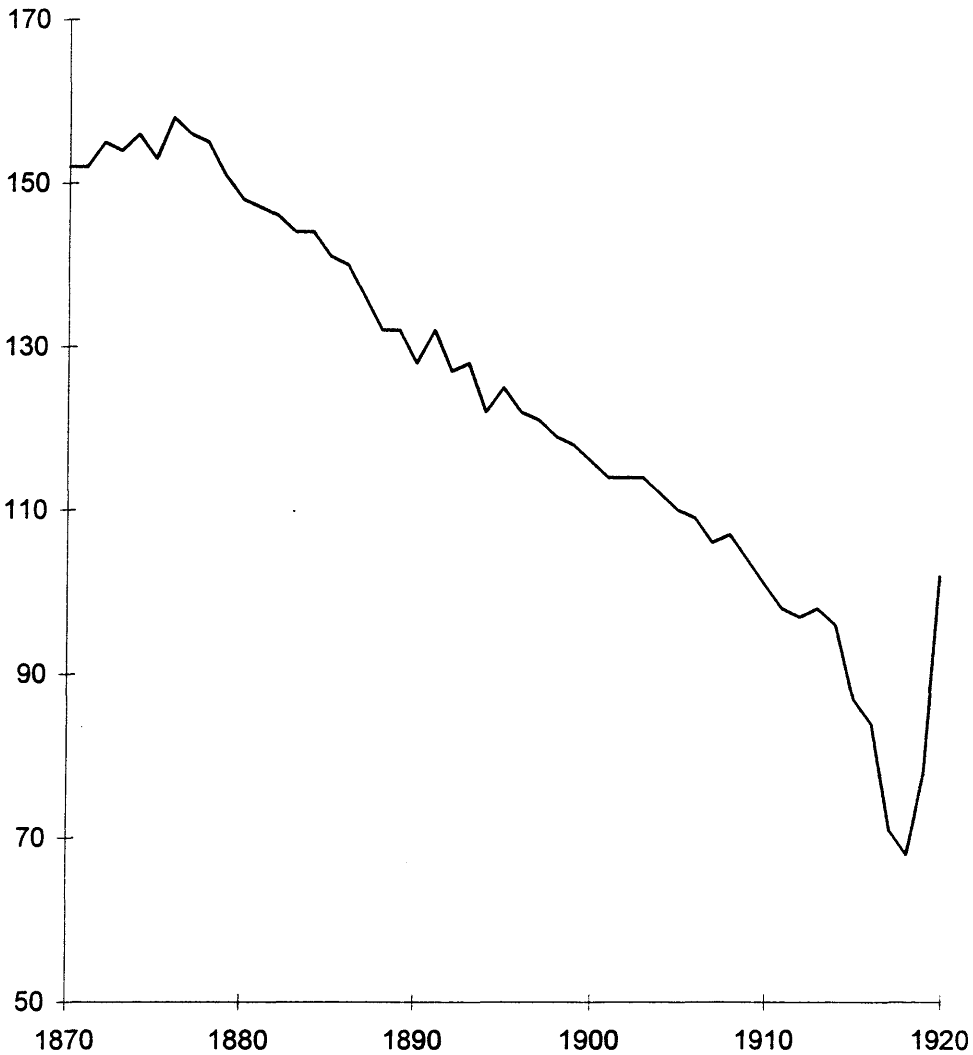
[1] ADL=Activities of Daily Living of bathing, transferring (to/from bed/chair) using the toilet, eating

Figure 1.1: Changes in the age distribution of the population; England and Wales, 1841-1996



Reproduced from Craig, 1987

Figure 1.2: General fertility rate, England and Wales 1870-1920

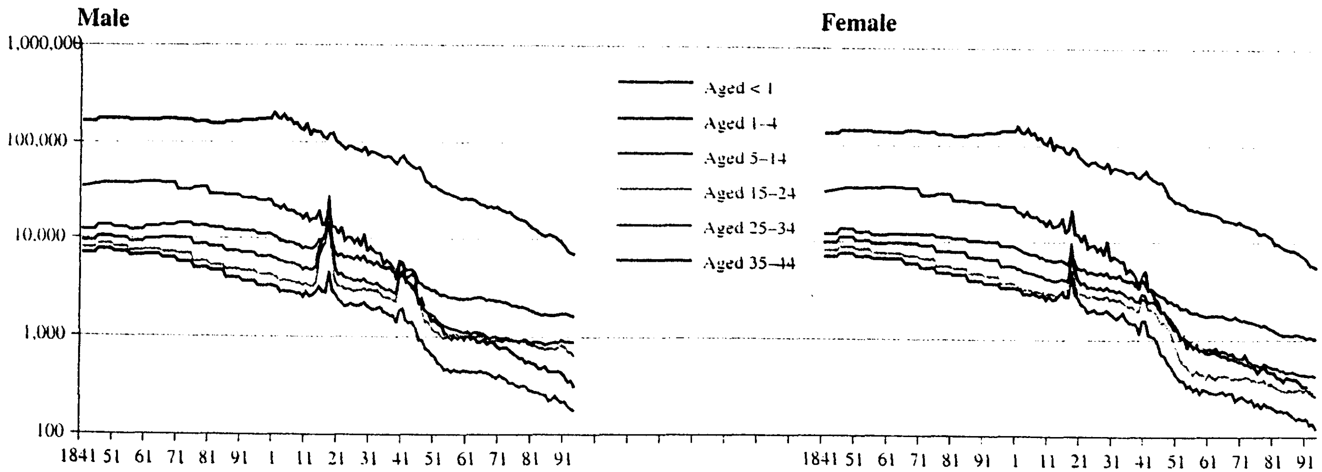


All births per 1,000 women aged 15-44

Source OPCS Birth Statistics Series FM1 no. 13.

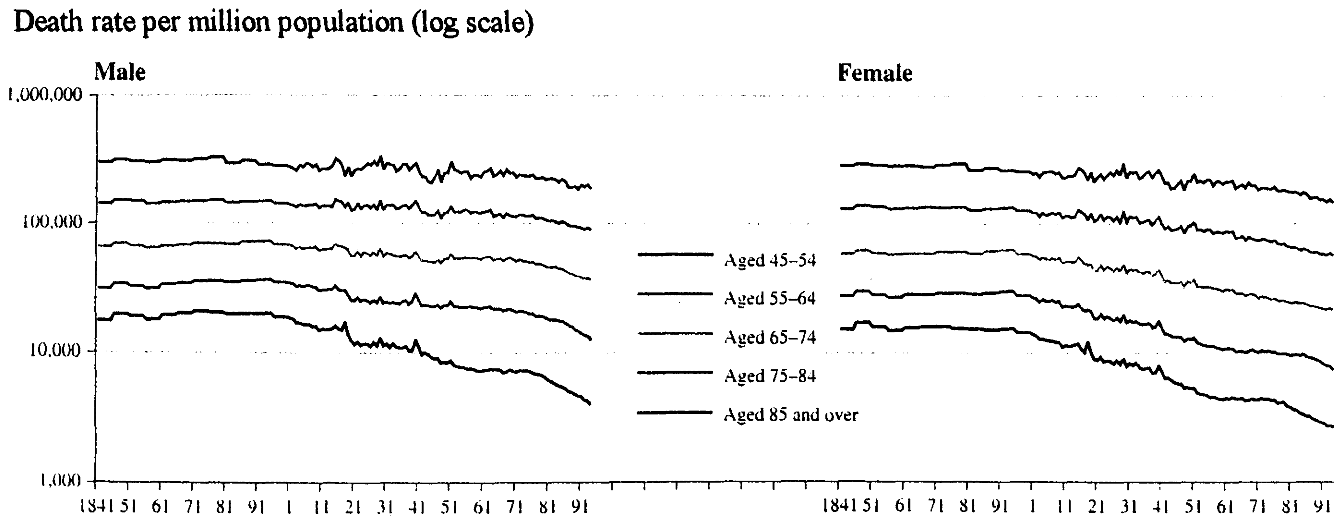
Figure 1.3: All cause mortality at ages 0-44 years, by age and sex: England, Scotland and Wales, 1841-1994

Death rate per million population (log scale)



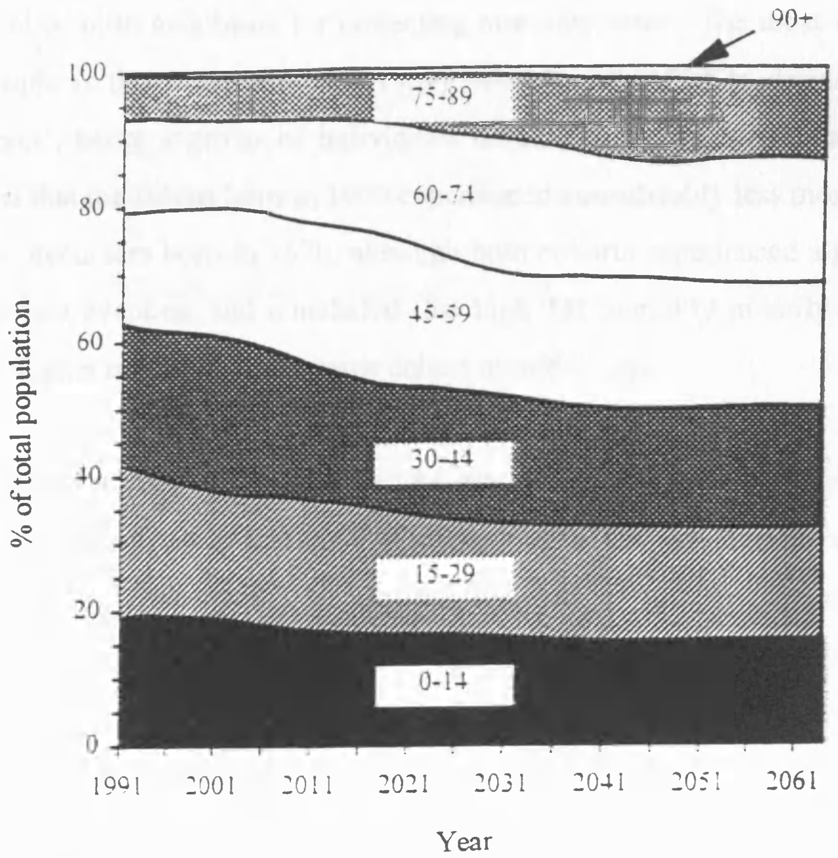
Reproduced from Charlton, J. 1997. Trends in all cause mortality: 1841-1994 in Charlton, J. And Murphy, M. (eds), The Health of Adult Britain, 1841-1994. Volume 1. ONS Decennial Supplement, No 12. London: The Stationery Office

Figure 1.4: All cause mortality at age 45 years and over, by age and sex: England, Scotland and Wales, 1841-1994



Reproduced from Charlton, J. 1997. Trends in all cause mortality: 1841-1994 in Charlton, J. And Murphy, M. (eds), The Health of Adult Britain, 1841-1994. Volume 1. ONS Decennial Supplement, No 12. London: The Stationery Office

Figure 1.5: **Actual and projected age distribution, United Kingdom, 1991-2064**



Reproduced from the Government Actuary's 1994-based projections

2. COHORT ANALYSIS

2.1 Historical development

The first systematic use of the cohort concept for data analysis is apparently due to Derrick (1927) in the actuarial literature, who used plots of age-specific mortality by period of birth as a basis for projecting mortality rates. The most widely known early example is the work of Frost (1939), who was the first to define and use the term 'cohort', being a group of individuals defined by proximity of dates of birth. Frost noted that the cohort born in 1900 experienced considerably less mortality from TB than their precursors born in 1870, although both cohorts experienced a peak of mortality in their late twenties, and concluded that high TB mortality in early life was associated with higher mortality in the same cohort in middle age.

A seminal discussion of the logic and method of descriptive cohort analysis is given by R.E.M. Case in a paper from the British Journal of Social and Preventive Medicine of 1956, recently reprinted in the Journal of Epidemiology and Community Health (Case, 1996). Case applied the method to age-specific rates of all-cause and disease-specific mortality. Figure 2.1, which is an example reproduced from Case's paper, shows lung cancer mortality rates from 1926 to 1954. The broken lines are cross-sectional mortality curves (also referred to as age-period curves or 'date-contours' in Case's terminology). These curves join mortality rates for populations at different ages observed at the same point in time. The solid lines are age-cohort curves, created by connecting mortality rates for five-year birth cohorts, observed as they age. The cross-sectional profiles show an apparent peak of lung cancer mortality in middle age, with declining rates from age 65 onwards. However, it would be mistaken to infer from this a protective effect of ageing, as the solid lines show that each cohort experienced rapidly increasing rates of mortality with age. The explanation for this apparent paradox is that the cross-sectional profile joins rates in middle age from cohorts born around the turn of the century, and having experienced very high lung cancer mortality, with rates in old age for men born earlier in the 19th century, into cohorts which experienced relatively low rates of lung cancer throughout their lifespan. The highest death rates of all are for men from the most recent cohorts at the time the figure was published, for whom data regarding mortality in old age were not then available. The explanation for the striking difference between longitudinal and cross-sectional age profiles is that any consistent underlying relationship between death rate and age is confounded with the effects of the much greater lifelong smoking rates for men born at the beginning of the 20th century, compared to those born fifty years earlier. Forecasts in 1956 of lung cancer mortality which did not take this cohort effect into account would have been disastrously optimistic, although it may also be added that forecasts based upon straightforward extrapolation of the trend across cohorts would equally be pessimistic, unless peaking of the smoking epidemic in the 1960s was also foreseen.

Korteweg (1951, 1953) first pointed out that an apparent anomaly between declining cross-sectional and increasing cohort age profiles will always occur where there are sufficiently large cohort effects, so that the difference in rates between cohorts exceeds the increase in rates with age. The effect upon the cross-sectional age profile of cohort differences of increasing size is illustrated in Figure 2.2, for linear age effects and constant increments between cohorts. Although prevalence increases as the cohorts age, the consequence of substantial cohort differences is a decline in prevalence with age estimated cross-sectionally, as observed in the lung cancer mortality data. The phrase 'lifecourse fallacy' has been coined by the sociologist Matilda White Riley in the 1970s to describe errors which arise from naive interpretation of cross-sectional age curves without accounting for cohort differences. Working with similar ideas but from a different tradition, Case draws upon the nature-nurture debate to form a theoretical argument for interpretation of the age-cohort rather than the cross-sectional age curves. His argument is that influences upon mortality have three classes, being inherent factors related to nature, influences of early nurture and influences of late nurture. Case argues that there will be a hard core of mortality attributable to nature which will result in an underlying age curve, but that this will be modified by environmental influences, so that measurement of the influence of social and environmental factors upon the experience of cohorts, is required, in order to build "a synthesis of knowledge derived from social history, medical history and cohort analysis".

Case concludes that "A necessary corollary to accepting the cohort analysis of a series of death rates as being the best biological interpretation of those given by the three methods of traverse is that we must abjure the vertical series [cross-sectional age profile] as a basis for the formation of biological theories, unless the rates at each age over the whole series...are constant, in which case the date-contours and the cohort series become identical." With this conclusion, and in his discussion of the potential for mispecification arising from the then customary use of the Gompertz curve to characterise the relationship of mortality with age, Case prefigures the identification problem which has dominated the ensuing literature.

2.2 The identification problem

The identification problem arises when we attempt to choose a mathematical model to adequately describe a series such as the mortality rates in Figure 2.1. The distinction between a set of age-cohort mortality curves varying across the cohorts by date of birth, and the set of cross-sectional age curves at each period of observation corresponds, in modern parlance, to two alternative mathematical models:

Two-factor age-cohort model

$$\log \lambda_{ik} = \mu + \alpha_i + \gamma_k \tag{2.1}$$

The constant term μ indicates the rate for a reference category; in this case the rate for a particular cohort at a particular age. The age term α_i is a function of the deviation in age from the reference age, and the cohort term γ_k is similarly a function of the deviation in years from the reference birth year. In this framework, differences in mortality rates are attributed to ageing, and to differences between cohorts observed at the same age. The model equation can be used to generate a set of mortality by age curves, one for each cohort, by substituting appropriate values for the cohort term.

The cross-sectional age curves translate into a different model:

Two-factor age-period model

$$\log \lambda_{ik} = \mu + \alpha_i + \beta_j \tag{2.2}$$

Under this model, μ is again the rate for a reference category, and differences in mortality rates are attributable to ageing, indexed by i, and to differences between age-specific rates from different periods of observation, with index j. A set of cross-sectional age profiles for mortality may be generated by substituting appropriate values for the period term β_j.

Each set of hypothetical rates in Figure 2.2 may be generated by either the age-cohort or age-period approach, using very simple linear equations (Appendix 2A). Similarly, but with greater complexity arising from reality, age-cohort models for the lung cancer mortality data could be fitted to produce smoothed versions of the blocked lines in Figure 2.1, whilst age-period models, with a rather different form for the relationship between mortality and age, could be fitted to produce smoothed versions of the broken lines. In fact, with these type of data, the analyst will always be faced with a choice of different but similarly well-fitting models to describe the data. This situation arises because age, period and cohort are inextricably related by the simple relation:

$$\text{Age}=\text{Period}-\text{Cohort} \tag{2.3}$$

where, for example, age is the age achieved in the year of observation, period is the year of observation, and cohort is indexed by year of birth.

The Lexis Diagram (Figure 2.3) is a graphical illustration of Equation 2.3. An individual's position at any point in the diagram can be uniquely specified by any two of the dimensions age, period and cohort. As any two of the three measures are sufficient to locate an individual uniquely in terms of the third measure, a model with parameters for age, period and cohort differences has one set of parameters that is redundant. For any fixed value of one parameter set, say age, and any set of rates, a best-fitting equation can be found by choosing appropriate values for the remaining two parameter sets, so that an infinity of solutions is possible, one for each possible set of age differences. Thus, the alternative forms of the age curve in Figure 2.1 are only two amongst an infinity of age profiles that can be fitted to the data, and finding a model for the data amounts to choosing between this infinity of solutions. The impossibility of simultaneously and uniquely identifying age, cohort and period effects is known as the identification problem. A more formal mathematical statement of this argument is given in Appendix 2B. The usual empirical criterion for model choice, goodness of fit, is of little use, and the choice of a final model from which to draw conclusions has instead to be based upon some form of prior theory or assumption.

Two-factor models may be viewed as special cases of a three-factor age-period-cohort model, incorporating the simple constraint that either period or cohort differences are zero. For example, adoption of the age-cohort model, on grounds that it is most consistent with biological explanations, involves the rather unsettling assumption that differences relating to period of observation do not exist, or at least are negligible. An alternative approach, which has become popular with the advent of software for multivariate modelling, is to include all three variables; age, period and cohort, in the modelling process and make a choice between alternative well-fitting models by adopting some constraint upon the parameters.

A form of constraint used by demographers and having the advantage of rendering analysis feasible before the advent of electronic computing, is to adopt a specific functional form for the age mortality profile, such as the Gompertz or Makeham curves. Approaches to cohort analysis in demography are discussed by Hobcraft, Menken and Preston (1985). Beard's analysis of lung cancer mortality in the actuarial literature was probably the first to make the need for such a constraint explicit (Beard, 1963). Rather than assume a shape for the age profile, Beard made a numerical estimate of the *cohort* profile, by assuming that the multiplicative effect of birth cohort upon lung cancer mortality was represented by the proportion in each cohort observed to be cigarette smokers.

Since the 1960s, there have been many applications of cohort analysis, spread across disciplines including demography, epidemiology and sociology. The term 'accounting frameworks' has been coined by Fienberg and Mason (1985) to describe three-factor age-period-cohort models which are not uniquely identifiable. The form of the model is generally as follows

$$\log \lambda_{ijk} = \alpha_i + \beta_j + \gamma_k \tag{2.4}$$

where i, j and k index age, period and cohort respectively.

The term 'accounting framework' has the dual advantage of emphasising that the models are nothing more than different mathematical formulae which can be used to account for the data, and that the variables 'age' 'period' and 'cohort' are not themselves effects, but indirect indicators for the operation of a mixture intrinsic factors and exposures and experiences upon the individual. For example, 'cohort effect' is used in epidemiology to denote the effect of early life experience and exposures such as nutrition and experience of infectious disease. (Barker, 1994; Maheswaran et al, 1997). However, in studies of older populations, 'cohort effects' may also represent effects of lifestyle and occupation during adult life, with studies of lung cancer and cardiovascular disease being examples. That age, period and cohort are essentially proxy variables is sometimes acknowledged by the use of the term 'difference', rather than 'effect', to describe the quantities represented by the parameter estimates.

Justifications for constraints to achieve identifiability of the three-factor age-period-cohort model range on a continuum from empirical through to theoretical. A rather sophisticated empirical approach was developed by Osmond and Gardner (1982) who chose a three factor solution by minimising a weighted average of the Euclidian distances between this solution and the three separate two-factor solutions. By contrast, in sociology it became common practice during the 1980s to impose a minimal constraint by taking two adjacent cohorts, and assuming their effects to be equal (for example, Glenn, 1977; Knoke and Hout, 1974). However, Rodgers (1982) demonstrated, using hypothetical data, that even apparently innocuous constraints can have a dramatic effect upon model parameters. This rather discouraging conclusion is supported in a comparison by McNally et al (1997), of three methods of cohort analysis applied to incidence data on non-Hodgkin's Lymphoma. This comparison supported the more cautious approach of Clayton and Schifflers (1987), based upon two-factor models, compared to an approach similar to that of Osmond and Gardner (De Carli and La Vecchia, 1987), and a method with effects constrained to be equal for pairs of adjacent cohorts (Robertson and Boyle, 1986). Clayton and Schifflers reject approaches which seek to 'solve' the identification problem. Instead, they fit models where the linear effects of period and cohort are both ascribed to 'drift'. An age and drift model has equal graduations between cohorts (and hence between periods). The hypothetical data in Figure 2.2 are generated from age and drift models. If the age and drift model is a good fit for the model, then no empirical distinction between period and cohort effects can be made.

However, if quadratic terms are included in the model, they do not suffer from the same problem of non-identifiability, so that degree of *change* in age, period or cohort differences can be estimated, even though the differences themselves are not identifiable. Thus, the point at which a trend across cohorts accelerates or reverses may be identified, but not the magnitude of the trend itself. However, these models require relatively long data series, if any useful conclusions are to be drawn. An identifiable point of transition in cohort differences is reported by Maheswaran et al (1997), who note that rates of stroke mortality declined faster in the South-East outside London, than in Greater London itself in the period 1951-1991. Whilst mortality was greater in the South-East than in Greater London during the 1950s and 1960s, this was no longer true for deaths amongst persons aged 45-74 years through the 1970s and 1980s. The decline in mortality cannot be readily ascribed to period or cohort effects, but the point of crossover of mortality rates between the two regions is indexed by cohort rather than period, and occurs at birth year 1917 for men and 1921 for women, suggesting that environmental influences in early life are implicated in stroke mortality.

Other researchers have looked to theory to underpin their choice of model. For example, Warshaw, Klerman and Lavori (1991) analyse data from a multicentre study of depression in the US population. They eschew statistical modelling, and concentrate instead upon interpretation of age-profiles of conditional probabilities of depression onset for each cohort. These plots are essentially cohort by age plots, with a shift in the horizontal axis. They reveal a dramatic increase in the rate of onset in the 1950s and 1960s, peaking in 1970 at ages over 40, but continuing through the 1970s in the younger age groups. Acknowledging that this effect may be interpreted either as an age-cohort or as an age-period interaction, the authors adopt the latter interpretation, on the grounds that this is plausible against a background of very rapid social and economic change in the 1950s and 1960s, and of theories concerning vulnerability to depression in different age groups.

The most rapid development of theory-based age-period-cohort models is in the field of cancer epidemiology, reflecting the development of theories of carcinogenesis. For example Lee and Lin (1996) propose the following model, based upon analysis of lung cancer data in Taiwan:

$$\lambda_{ij} = (\alpha_i + \gamma_k.\delta_i).\beta_j \tag{2.5}$$

where λ_{ij} is the incidence or mortality rate for a particular cancer, α_i represents the age-specific rates for a reference cohort , $\gamma_k.\delta_i$ represents an age-cohort interaction, where cohort differences due environmental exposure have differential effects across the agespan, and β_j represents period effects such as more complete case ascertainment through improved diagnostic procedures and registration. The choice of model form is justified by reference to epidemiological theory, and the model is identifiable because of the different forms (linear and exponential) for the cohort and period effects. The theoretical basis for the model integrates biological and environmental effects, as well as allowing for artefacts of measurement.

Applications of cohort analysis in gerontology which use constraints based upon theory, rather than empirical choice, are less well-developed. However, within the field of sociology a body of theory does exists, known as age-stratification theory, which can be drawn upon to underpin age-cohort analyses of morbidity and health behaviour in elderly populations.

2.3 Age-stratification theory

Age-stratification theory was proposed by the sociologist Matilda White Riley in a series of works in the 1960s and 1970s as a general perspective for ageing research (Riley, Johnson and Foner, 1972; Riley 1973). The theory builds upon the writings of the demographer Norman Ryder (Ryder, 1965). Both Riley and Ryder use the term 'cohort' to refer to a group of people defined by contemporaneous experience of a critical event (usually birth), and both have emphasised the potential of the cohort as a unit of analysis in the study of social change. Ryder brought together developments of cohort analysis in demography with the literature referring to the role of cohorts in the history of arts and sociology. In particular, he linked the work of Karl Mannheim (Mannheim, 1952), to the process of cohort replacement, which Ryder terms 'demographic metabolism'. For Ryder, social change is made possible by the encounter of each new cohort in young adulthood with the prevailing social landscape, and their assimilation by the process of socialisation. Social change is interdependent with cohort differentiation, arising from the interplay of cohort size and composition and differential contributions of institutions, such as family, peer group and educational institutions to the process of socialisation. Furthermore, he gives a detailed analysis of how cohort differentiation arises from historical influences such as war, migration and urbanisation. However, Ryder's demographic analyses focused upon fertility, and he was primarily concerned with social and political change, so that his major works on cohort analysis are only marginally concerned with health and the biological process of ageing.

In developing age-stratification theory, Matilda White Riley builds a more general framework based upon the ideas set out by Ryder, and considers in detail the implications for quantitative analysis of health in elderly populations. The theory is set out in detail by Riley and colleagues in "Ageing and Society: a Sociology of Age Stratification" (Riley, Johnson and Foner, 1972) and was developed out of structural functionalist theory of Talcott Parsons, which dominated American sociology in the 1950s and 1960s (Ritzer, 1996). In brief, Parson's theory emphasises the importance of social structures, encompassing normative roles, with individuals assuming roles via processes of socialisation and allocation operated by educational and economic institutions. Ideas of social stratification are a central theme. Since the 1960s, structural-functionalism has been heavily criticised in the sociological literature. Among the key weaknesses is over-emphasis upon structure which means that the theory allows for only limited and orderly social change, and neglect of interindividual heterogeneity within strata.

Riley's work builds upon Parsons', in that age strata are seen to form part of the social structure, with roles being defined in relation to age. The building blocks of age-stratification theory consist of four structural elements and four processes, described in a diagram which is reproduced in Figure 2.4. People of similar age are grouped into age categories or age strata. Stratification is motivated by recognition that not only acts and capacities of people, but also the social roles open to them, and expectations and sanctions governing their performance within these roles, are age-related. Parsonian concepts of allocation and socialisation are adopted to explain the assignment of persons to roles, and the development of behaviour within those roles. The aspects of this theory which were novel at the time, and are of most relevance here, are emphasis upon ageing and cohort flow as dual processes which drive a dynamic model by accounting for movement of people through the social system, together with identification of roles which are differentiated by age, as opposed to gender or socioeconomic status.

Ageing is defined as biological, physical and social ageing, although the relative contributions of these three components remains to be described. Ageing results in intraindividual changes in activities and roles. Meanwhile, as cohorts move onwards with age, the age-related roles and activities that they leave behind are taken up by succeeding cohorts. Drawing upon Ryder, the processes of ageing and cohort flow are used to provide insights into social change. The first insight is Riley's observation that these processes are not synchronised, so that there will be strains generated as a result of mismatch between size and composition of cohorts as they reach certain ages. An example is the increase in the numbers in the oldest cohorts and pressures upon arrangements for financing long-term care, a conflict which was already being acted out as the present study cohort reached old age in the 1980s. Strains may arise from influences within the system, such as changes in birthrate and survival affecting cohort flow, or may be due to exogenous influences, such as environmental or historical changes. An example of the latter is scarcity of males in the cohorts that fought in World War I. A second, related, insight is that the process of ageing varies across cohorts, in response to their particular historical, social and environmental situation. In contrast to structural functionalism, Riley's framework is dynamic in approach, and more suited to longitudinal analysis. In recent work the link with functionalism has been downplayed, with Riley choosing to rename her model the 'Ageing and Society Paradigm' (Riley, 1993).

For Riley, the central problems of ageing research are to disentangle the processes of ageing and cohort succession, and to investigate the interrelationships between these and environmental, historical and social factors. These concerns are in the spirit of Robert Case, and Riley's work may be viewed as providing a dynamic model for the synthesis of social and medical history which was called for in Case's 1956 paper. Although the work of Ryder and Riley provide a sounder basis for interlinking social change, ageing and cohort flow, this is yet to be integrated fully with biological models of ageing.

For empirical analysis, the major implication of Riley's theoretical framework is the need to recognise and model cohort differences. Riley makes the following prescription for theory based descriptive cohort analysis: "The search for possible explanations in terms of 'cohort effects' and 'period effects', fraught with difficulties, can often be aided ... by attempting both types of analysis, and hoping to isolate one set of findings that shows greater empirical regularity and is, at the same time, consistent with an acceptable theory." (Riley, 1972, pp35-49). In later works, the importance of identifying and measuring substantive effects, rather than the proxies of age, period and cohort is emphasised. (Riley, 1994).

In the following section, analyses in gerontology which have applied this analytical approach in practice are reviewed.

2.4 Cohort analysis in gerontology

An age-stratification approach to the study of health in older people has been developed by Fredric Wolinsky and colleagues, in detailed studies of health service utilisation in the US. Their analysis includes eight four-year birth cohorts aged 56 and above from the Health Interview Survey (HIS), interviewed in the 1970s and early-mid 1980s (Wolinsky, 1990; Wolinsky, Mosely and Coe, 1986; Wolinsky and Arnold, 1989). Two distinct but complementary methodologies for cohort analysis are employed. Firstly, standard cohort tables are inspected visually for consistent differences with age, period or cohort (for example, Wolinsky, 1990). An example of a standard cohort table for self-rated health of elderly Americans reported in the Health Interview Survey is given in Table 2.1. A formal strategy is used, first inspecting for age differences by intracohort (diagonal) comparisons, then for period differences by comparisons across surveys by age (row comparisons) and then finally for cohort differences by comparisons within surveys by age (column comparisons). In each case, the comparison confounds two of the three differences of interest. For example, differences in the proportion with very good or excellent health along the diagonals in Table 2.1 may be ascribed either to ageing, or to the different periods of observation. The methods used to interpret the tables in the face of confounding of age, period and cohort are not fully described, but seem to incorporate implicit theoretical assumptions, prioritising first age, then period and finally cohort differences. This issue will be discussed in more detail in Chapter 8.

For modelling, Wolinsky rejects the accounting framework for reasons of complexity and sensitivity to choice of constraint (Wolinsky, 1990 pp 32 and pp94). Instead, Wolinsky and colleagues introduce an alternative methodological approach, termed "regression-based cohort analysis" (Wolinsky, Coe and Moseley, 1987). The motivation for this is to incorporate covariates, in order to investigate the Andersen behavioural model for health service use (Andersen and Newman, 1973), within an age-period-cohort framework. Since the Andersen model relates health service utilisation to predisposing, enabling and need factors, these are also included in the model. In the regression-based cohort approach this is achieved by fitting regression models for predisposing, enabling and need factors separately for each survey. Within surveys, the effect of age is modelled by including dummy variables for each cohort surveyed, with a reference cohort to achieve identifiability, as usual. The resulting unstandardised regression coefficients are then themselves subjected to comparisons by age, period and cohort. So, for example, the analysis allows statements such as there is an intercohort difference, with the effect of education upon self-perceived health being stronger in the newer cohorts. To deal with sampling variation, Wolinsky suggests using criteria of non-overlapping confidence intervals. A further development is to fit regression models within each cell of the standard cohort table (for example, Wolinsky, Arnold and Nallapati, 1988). This approach has been used with the present data, and the advantages and disadvantages will be considered in Chapter 6. In contrast to the present work, Wolinsky uses ordinary least squares regression with the dependent variable assumed to be normally distributed. It is noted that this will give similar results to logistic regression if the observed proportions in subgroups are not too close to zero or unity.

Wolinsky and colleagues have used analyses based upon the age-period-cohort framework to question the assumed relationship of health service utilisation with age, demonstrating that the increase in health service utilisation with age may be accounted for by concomitant increases in activity limitation and decreases in levels of self-perceived health (Wolinsky, 1990 pp 225). However, the conclusion of no ageing effect may be dependent upon the method of analysis, as it is indirectly contradicted in a previous analyses of the same dataset (Wolinsky, Arnold and Nallapati, 1988; Wolinsky, Coe and Mosely, 1987). Wolinsky and colleagues have also documented increased rates of dental contact in middle and old age across eight four-year birth cohorts born from 1885-1916 (Wolinsky, 1990; Wolinsky and Arnold, 1989), and period differences in physician and hospital use which may be attributed to policy changes with regard to the financing of US health care (Wolinsky, 1990 pp221-222). This thesis covers some similar ground to the above analyses but in a UK context, and the analyses of self-perceived health, activity limitation and physician visits from the HIS will be reviewed in more detail in the light of results presented in Chapter 5.

The most detailed studies of cohort differences in health in an older population outside of the US is probably those of the population of Göteborg, Sweden by Alvar Svanborg and colleagues (Svanborg, 1988). They studied a representative sample of the population born in the years 1901-1902, 1906-1907 and 1911-1912, and found cohort differences in intellectual functioning, height and weight. In respect of health, prevalence of a range of disorders were analysed, with differences being small, with the exception of a marked improvement in oral health, and some indication of an increase across cohorts in the prevalence of osteoarthritis.

Other applications of cohort-based methodology in the published literature on health in elderly populations are rare. A report from the Tampere longitudinal study Jylhä (1994) focused on use of medicines in the older population, and is restricted to a single comparison between two cohorts at age 60-69, surveyed in 1979 and 1989. The cohort comparison revealed a significant increase in use of drugs, whilst the proportion using prescribed drugs also increased in the earlier cohort between 1979 and 1989. The cohort difference, perhaps better described as drift, is ascribed to a period effect due to changes in drug regulatory policy in the 1980s. Antilla (1991) reports measures of health in a community-based populations aged 75 years and over in Finland, surveyed in 1978 and 1988. In comparisons unadjusted for age, there were significant declines in functional capacity, measured using ADL, IADL and mobility. However, within the study cohorts, the proportion aged 85 years and over increased from 8% to 13%, so that the cohort difference in average functional capacity may be at least partially due to population ageing. Winblad (1993), in a similar study, describes the health of a different Finnish population, interviewed in 1979 and 1989. Although the mean number of activity limitations was higher within each five year age group in 1989 than in 1979, there was no statistically significant evidence of period or cohort differences.

2.5 Approach adopted in the present study

The essential methodological approach of this thesis is interpretations of age-cohort and age-period profiles, assisted by estimates of sampling variation derived from two-factor age-cohort and age-period models, to explore trends and generate hypotheses relating to ADL dependency, self-perceived health and contact with a GP in the past month in the population aged over 75 years. Two-factor models have the advantage of being identifiable and having parameters with straightforward interpretation. Because there are only two measurement occasions and three cohorts with reasonable numbers of people observed, any constraint used to resolve the identification problem would have a substantial effect upon the analysis. Therefore the three factor models involving age, period and cohort effects simultaneously are not considered.

A similar approach has been used in analysis of a 24-year longitudinal study of pulmonary function in Dutch adults. Xu et al (1995) fit both age-period and age-cohort models, to estimate cross-sectional and longitudinal effects of ageing on FEV_1 and demonstrate how cross-sectional estimates of the age curve may be biased by cohort differences. They report significant cohort effects, from the age-cohort models, and significant period effects, from the age-period models, but do not attempt to choose between them. The conclusion, of significant period and cohort effects, risks ambiguity, as it does not acknowledge the extent to which these two conclusions may be confounded.

As has already been discussed earlier in this chapter, in order to make sense of the data it is necessary to make some underlying assumptions about the way in which differences related to age, period and cohort arise. In keeping with other work, the existence (but not the nature or immutability) of ageing effects upon health is assumed, so that period-cohort models are not considered. Following the logic of Case, underpinned by age-stratification theory, the primary weight of interpretation is borne by the age-cohort, rather than age-period models. However, the interpretation of age-cohort models is qualified in the light of prior theory combined with the result of the age-period analysis. This approach attempts to account for the health experience of cohorts in the face of possible period differences which are viewed as confounders. So whilst models are fitted in both frameworks, it is the age-cohort models which are interpreted first, but then qualified in the light of possible confounding by period effects.

For example, in the analysis of ADL function, it is theorised that the disability reported in the sample is the product of an ageing process which may differ between cohorts due to their differential exposure both to damaging (smoking, war) and preventative (the NHS) influences. Thus, the underlying process may be described in an age-cohort framework. However, the possibility that differences in measurement procedures, reporting behaviour and physical environment between the two occasions may induce period differences is investigated in secondary analyses, and by incorporating side information, and accounted for in the interpretation.

This analytical approach is based upon two premises:

1. That the aggregated macro-level data available from linked cross-sectional surveys are most appropriately used for description of trends and for hypothesis generation, rather than hypothesis testing.

2. That the majority of the experiences, exposures and intrinsic factors which might influence health can be adequately represented within the dimensions of age and cohort, and that influences relating purely to the period of observation play a secondary role. This premise is perhaps more questionable, and will be discussed in detail in Chapter 8.

Logit modelling (Aitken et al, 1989) is used for the analysis. Technical issues relating to the modelling process are dealt with in Chapter 4. In each analysis, the best-fitting model is obtained, firstly within an age-cohort, and secondly within an age-period framework. Within each framework, models with main effects and interactions are considered, together with models in populations stratified by covariates. The objective of the analysis is hypothesis generation, rather than hypothesis testing, and in each case, conclusions are drawn from the best-fitting age-cohort model, with due qualification for the possibility of confounding by age-period effects, investigated by models in the age-period framework. Although this approach is essentially descriptive, and cannot produce conclusive evidence, it can reveal differences which are worthy of further investigation by other research designs and which may inform suitably cautious predictions of requirements for health care.

2.6 Summary

This Chapter reviews approaches to cohort analysis, and outlines the main analytical approach of the thesis. The value of analysing data series by age and birth cohort has been recognised since the 1930s, and there are streams of literature in demography, sociology and epidemiology. By the 1950s it was recognised that longitudinal and cross-sectional age curves may be different, and the epidemiologist Robert Case called for a theoretical basis combining medical and social history, in an elegant justification for cohort analysis in 1956.

Non-uniqueness of estimates from three-factor models involving age, period and cohort has been recognised since the 1960s. Analyses of both hypothetical and real data suggest that estimates of age, period and cohort effects are sensitive to the choice of constraints used to achieve estimability. Theory-based models which are identifiable and use non-linear effects have been developed in cancer epidemiology. Clayton and Schifflers argue that cohort and period effects cannot be separated empirically, and propose age and drift models, which do not differentiate between linear effects for period and cohort.

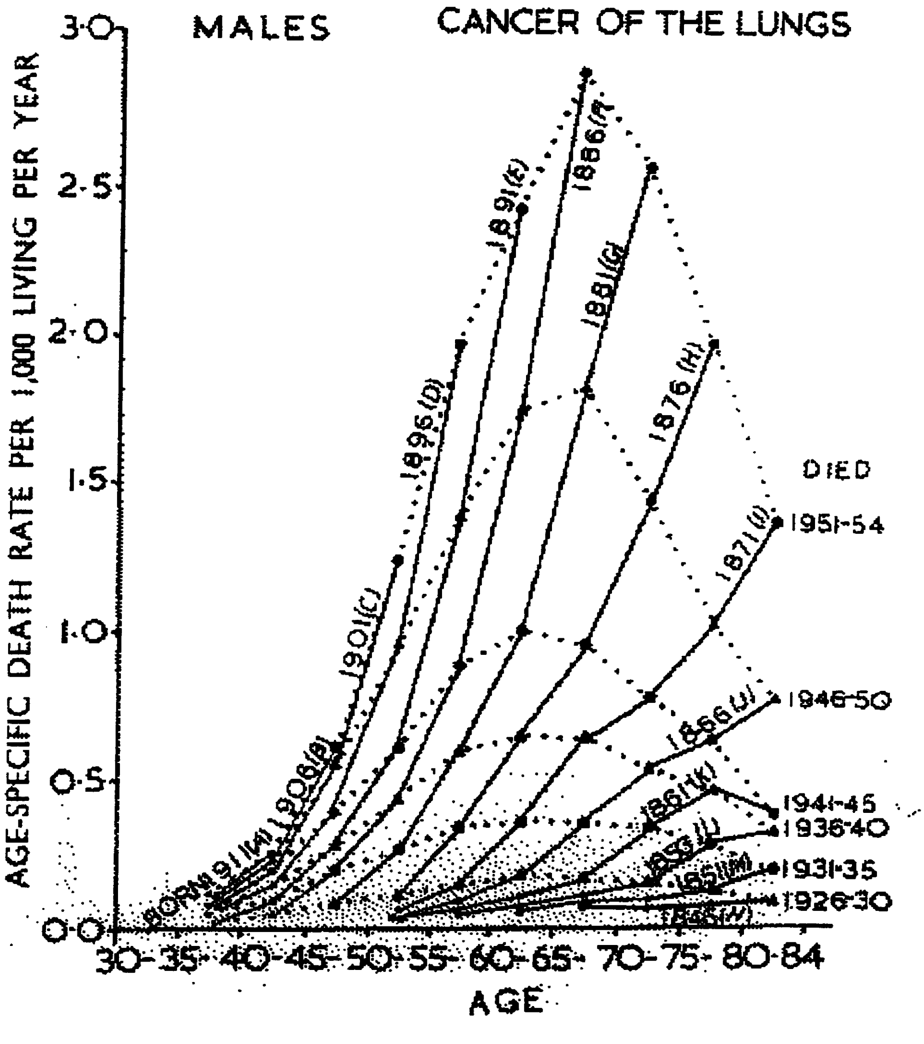
A theoretical basis for analyses of health in elderly populations is supplied by the age-stratification theory of Matilda White Riley, which emphasises the dual processes of ageing and cohort flow, so that patterns of ageing may vary across cohorts. Two-factor age-cohort and age-period models are identifiable and have readily interpretable parameter estimates. The analytical approach in this thesis involves interpretation firstly of age-cohort profiles and age-cohort models, with qualification to allow for the possibility of confounding by period effects.

Table 2.1: Standard cohort table showing percentage of participants rating their health as either excellent or good, by survey year and age group, from the health interview survey

Age group	1972-73	1976-77	1980-81	1984-85
76-79	56	68	68	66
80-83	66	68	69	63
84-87	67	65	69	63
88-91	71	70	68	66
92-95	73	70	75	62
96-99	67	74	78	50

Reproduced from Wolinsky, 1990; New York: Springer pp113

Figure 2.1: **Mortality rates for cancer of the lungs, England and Wales 1926-1954: males**



Reproduced from Case, 1996 J Epid Comm Health ;50:114-124

Figure 2.2: Interrelationship between cohort differences, age-cohort profiles (blocked lines) and cross-sectional age curves (broken lines)

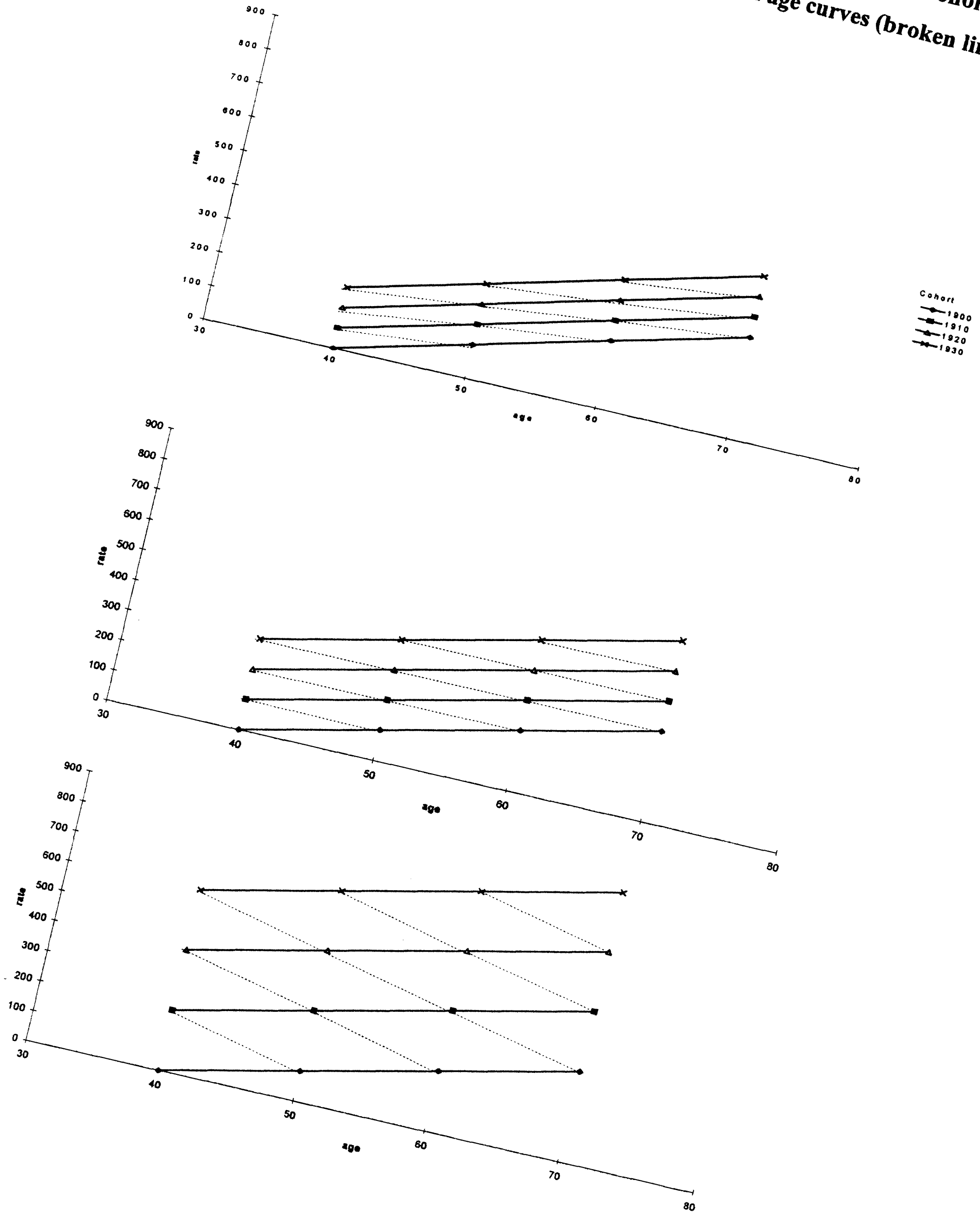


Figure 2.3: The Lexis diagram

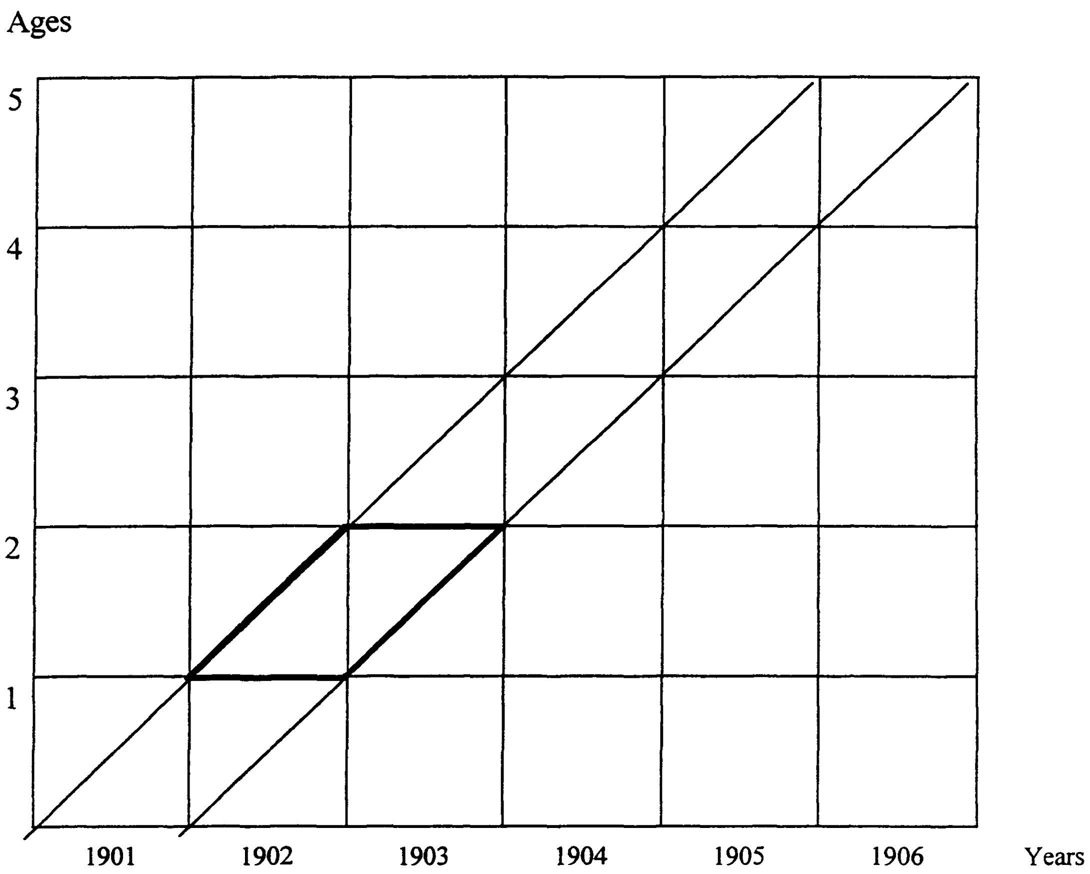
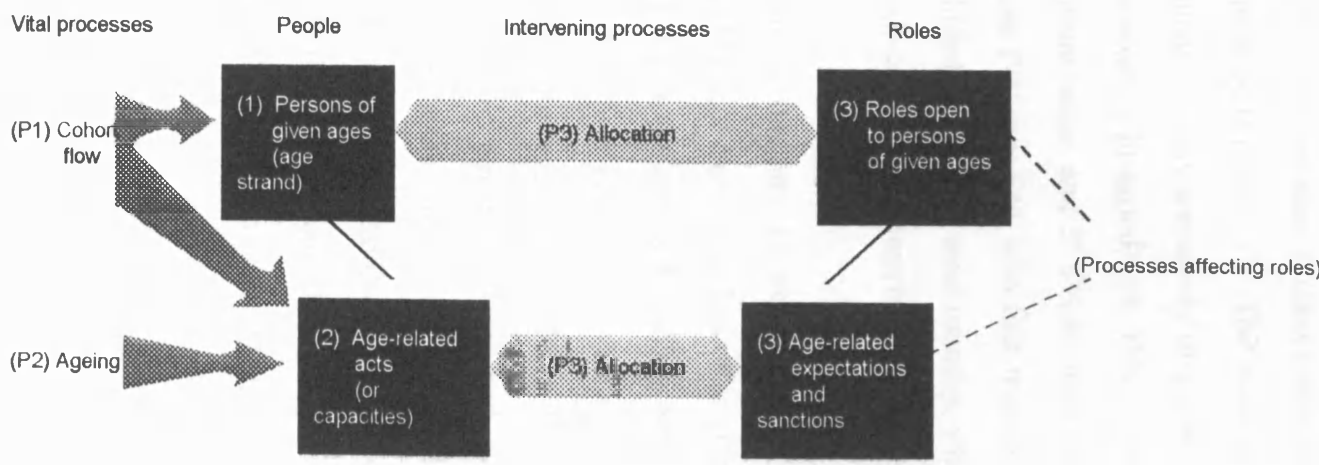


Figure 2.4: The age stratification perspective



Reproduced from Riley, M., Johnson and Foner (1972). Ageing and Society Volume III: A sociology of age stratification (pp 9). New York: Sage Publications

3. THE STUDY POPULATION

3.1 Melton Mowbray

Melton Mowbray is a medium-sized market town, surrounded by fertile countryside in North-East Leicestershire (Figure 3.1). The local economy is mixed, with agriculture providing employment for only a minority of the working population. In 1981, 9% of employed residents worked in agriculture, 37% in manufacturing, 15% in construction, transport and communication, and 37.5% in other services. The largest manufacturing employer is Pedigree Petfoods Ltd, who first moved to the town in the nineteen-fifties. Other industry included an iron and steel foundry, which closed in the nineteen-eighties, and some other small-scale manufacturers, including boot and shoe factories.

Melton was chosen in the late 1970s to be the site of a population laboratory, established by the Medical School at Leicester (Clarke, 1995), its suitability arising from the fact that the town and surrounding areas are served by a single General Practice, which in 1981 had 12 partners, and a list size of over 32,000, rising to 14 partners and a list size of over 32,500 in 1988. The practice list provided the sampling frame for a varied set of epidemiological and evaluative studies of older people, including the total population surveys of 1981 and 1988 which are analysed in this thesis. The practice population is similar to, but not coterminous with the population of Melton district, with the district population being 42,910 in 1981 and 45,112 in 1988. Melton district is fairly similar in terms of age-sex distribution to the population of England and Wales (Figures 3.2 and 3.3). Sex ratios for Melton district and Great Britain are given in Table 3.1. In 1981, the ratio of women to men was somewhat lower in Melton than in Great Britain as a whole, but in 1988 this difference was reversed. There was an increase in both the numbers and the proportion of the population aged over 75 years in Melton between 1981 and 1988, which mirrors the national picture (Figure 3.4). Within this age-range, as nationally, the proportion aged 85 years and over also increased.

Whilst the setting is a mixture of market town and rural, the socioeconomic mix in Melton is quite heterogeneous, and the distribution by Registrar General's classification for all persons over 16 is very similar to that for Great Britain (Table 3.2). The number of households without a car is somewhat lower than the national average (22.1% against 32.6%; census 1991), but this may reflect the rural location, rather than levels of absolute deprivation. It is however likely that the most deprived households are underrepresented in Melton. The proportion of households with no central heating in 1991 was 15.7% in Melton, compared to 18.8% nationally, and the proportion without exclusive use of a bath or shower was 0.6%, compared to 0.9% in Great Britain as a whole.

Melton has two NHS community hospitals, and in the 1980s these provided around 120 beds, including medical, surgical and maternity wards. The majority of beds (74) were allocated to geriatric care, under the supervision of consultants from the Leicester General Hospital. These beds would usually be occupied by Melton residents, referred in the first instance to the General Hospital. For the remaining beds, it was customary for the GP practice to refer to the Melton Hospitals, if there was a bed available, or otherwise to the Leicester General Hospital or Leicester Royal Infirmary. Long-standing staff currently employed at the practice and the Melton hospitals do not report any significant change in availability of beds or referral policy during the 1980s. However, in 1982, the General Practice moved to a purpose-built surgery in the centre of the town, with enhanced equipment including operating theatres, which may have resulted in some substitution of care at the practice for referral to acute hospitals.

3.2 The study cohorts

The study population consists of all individuals aged over 75 years identified on the computerised age-sex register for the Melton practice on December 31st 1980, together with all individuals aged over 75 years identified on the age-sex register on 31st December 1987. Mortality data were retrieved by flagging participants at the NHS Central Registry. Participants were interviewed at their place of residence, whether at home or in an institution, by fieldworkers who were trained by the same researcher at each survey. The first data collection period lasted from January to October 1981, with 54 interviews completed in the pilot survey in July and August 1980. The second data collection was completed in early 1988. The interview lasted for around one and a half hours and included information on health, sociodemographic status, use of services, usual activities and personal finances. Response rates were high; only 5% refused at each survey, and when non-contacts and deaths are taken into account, the proportion of the total population interviewed was 91% in 1981 and 84% in 1988 (Table 3.3).

Subjects were divided into seven-year birth cohorts, corresponding to the interval between surveys. Five cohorts were identified, with birth years 1878–1884, 1885-1891, 1892-1898, 1899-1905 and 1906-1912. However, there were only 7 survivors in the oldest cohort, aged 96-102 years in 1981. Although investigation of trends is restricted by the relatively short timespan of seven years, the surveys may be used to compare the health, as they age, of cohorts born in 1892-1898, 1900-1905 and 1906-1912. Whilst the oldest cohort were young adults at the time of World War I, of an age to have young families during the Great Depression, and already well into middle age in 1948, the youngest cohort, born in 1906-1912, did not reach median childbearing age until well into the nineteen-thirties (Bartley, Blane and Charlton, 1997 pp75), and could rely on the NHS for healthcare from their middle adult life. Members of this cohort was also born late enough to benefit from the revival of interest in the development of public health which occurred at the beginning of the century, described by Brockington (1966). The years 1901-1912 saw a succession of legislation, such as the Midwives Act (1902), the Education (School Meals) Act, 1906 and National Health Insurance 1911, which might be expected to be advantageous for the healthy development of children born and growing up at that time, compared to their precursors born a few years earlier. This is supported by the declines in infant mortality discussed in Chapter 1. The populations identified in 1981 and 1988 are, of course, survivors of a much larger cohort. Just under 25% of males born in 1896, and just over 35% of females survived to age 75 years. This compares with the cohort born in 1906, of whom 33% of males and 50% of females survived to age 75 years (Grundy, 1997 pp203). This gain in survival is due to the combined effects of improvement in infant mortality rates in the early years of the century and declining mortality rates in early old age.

A summary of the elderly population identified on the age-sex register at the two surveys, by year of survey and place of interview is given in Table 3.4. Fixed availability of institutional places within the practice boundary means that the proportion interviewed in institutions declined between 1981 and 1988. However, within Melton district as a whole, the proportion of people aged 75 years and over living in institutions increased from 7.5% in 1981 to 9.5% in 1991 (source: Census). This increase is broadly in line with the growth reported by Grundy and Glaser (1997), in analysis of linked census data in the ONS Longitudinal Study for England and Wales. Encouraged by changes in the administration of social security benefits from the early 1980's onwards, there was a rapid expansion in the number of places available in privately-financed residential care between 1981 and 1991, both nationally and in Leicestershire. This increase in privately funded places was only partly offset by a marked reduction in numbers of NHS-funded geriatric and psychiatric beds (Campbell-Stern et al, 1993; Tinker et al, 1994). Comparison between the 1981 census for Melton District and the 1981 total population survey reveals that there were 88 people aged 75 years and over living in institutions within the district, but either outside the practice boundary, unregistered with the practice or included in the non-contacts in the 1981 survey. Thus, it is probable that there were a number of institutional places within easy reach just outside the practice boundary. By the 1991 Census, the total number of institutional places occupied by persons aged 75 years and over in Melton District had risen to 259. Some of this expansion in places may have occurred after 1988, but it is also likely that losses from the practice population include frailer members moving to residential care outside the practice boundaries. Detailed information on migration is not available, although the 1988 questionnaire included a question on residence, indicating that 13% of the population interviewed in 1988 had moved to their present address from a distance of at least 5 miles since 1978.

3.3 Five-year survival and sociodemographic characteristics

By five years from interview 41.9 percent (504/1203) of the 1981 study population had died, compared to 39.2 percent (619/1579) of the 1988 study population. The probability of survival at various time points from interview is shown in Table 3.5 and indicates decreased survival with increasing age. Comparison of the same age groups across the study period indicated some increase in survival for women in the more recent cohorts, not reaching statistical significance. However, the men aged 75-81 years interviewed in 1988 had worse survival than men interviewed at comparable ages in 1981.

More than half the women, but only one in five men lived alone (Table 3.6). Between 1981 and 1988 there was a decrease in the proportion who were married, and an increase in the proportion who were living alone, mostly attributable to widowhood. The increase in the proportion living alone was most noticeable amongst the men. There was a considerable increase in the number of people living in wardened or sheltered accommodation, from 101 (9% of those interviewed at home) in 1981 to 198 (13% of those interviewed at home) in 1988. There is a shift in social class distribution away from classes IV and V between 1981 and 1988, observed amongst both men and women. However, the data on social class for women should be treated with caution, as many of these women will not have worked, and social class is attributed from a husband who may be long dead, or even a father, for single women who had not worked. The shift away from classes IV and V may partly reflect a decline across cohorts in the numbers employed as farm labourers.

Changes in survival, and in conditions in the early years around and after 1900, suggest gradual but undeniable sociodemographic change, with implications for the health of these cohorts in old age. This may be combined with effects trends in socioeconomic status and lifestyle. It is against this background, that the evidence for cohort differences in the health of these cohorts as they age beyond 75 years is examined in the remaining chapters of this thesis.

3.4 Summary

Melton Mowbray was chosen in the late 1970s to be the site of a population laboratory, established by the Medical School at Leicester. The setting is broadly representative of England and Wales in terms of age-sex and socioeconomic distribution. The town and environs of Melton Mowbray are served by a single General Practice with list size of over 32,000, with the practice age-sex register providing the sampling frame for repeated cross-sectional surveys of the total population aged 75 years and over identified on 31st December 1980 and 31st December 1988.

Participants were interviewed in their own homes or in hospital or long-term care by trained fieldworkers, and the interview included a range of sociodemographic and health measures. The rate of institutionalisation fell between 1981 and 1988, apparently due to fixed supply of places. However, there may have been an increase in migration out to institutions beyond the practice boundary. There was limited data on migration into the practice, but no information was available on migration away. The population was divided into seven year birth cohorts, born 1885-1891, 1892-1898, 1899-1905 and 1906-1912. Whilst five-year survival rates improved for women, comparing participants interviewed in 1981 and 1988, rates of survival were slightly lower for men aged 75-81 in 1988 than in 1981. There was a decrease in the proportion who were married between the two surveys, and increase in the proportion living alone. There was also an apparent decline in the proportion in social classes IV and V, although validity of the measure of social class in this population is in some doubt.

Table 3.1: Sex-ratios: Melton District and Great Britain, 1981 and 1991

	1981		1991	
	GB	**Melton District**	**GB**[2]	**Melton District**
All ages	1.06	1.03	1.07	1.04
Age 75 and over	2.09	1.96	1.93	1.98

Source: census

Table 3.2: **Distribution of socioeconomic status: Melton Mowbray and Great Britain, 1991**

	1991			
	GB		Melton	
	% (base = all economically active)	% (base=all)	% (base = all economically active)	% (base=all)
Males				
I	6.5		5.7	
II	26.2		27.4	
III(N)	10.4		8.2	
III(M)	30.7		31.0	
IV	14.7		15.7	
V	5.1		6.4	
Other[1]	6.4		5.6	
Total economically active	100.0	73.7	100.0	76.2
Retired		17.0		16.8
Other inactive		9.3		7.0
Total		100.0		100.0
Females				
I	1.8		1.5	
II	26.5		24.4	
III(N)	37.5		34.8	
III(M)	6.9		8.1	
IV	16.1		19.8	
V	7.0		8.0	
Other[1]	4.2		3.4	
Total economically active	100.0	50.4	100.0	50.4
Retired		20.1		18.9
Other inactive		29.5		30.7
Total		100.0		100.0

Source: census

[1]Includes armed forces, persons on government schemes, and inadequately described

Table 3.3: Population surveyed

	1981	1988
Date Population Drawn	31.12.80	31.12.87
Number aged 75+ identified	1329 (100%)	1890 (100%)
Died before interview	50 (4%)	139 (7%)
Non-contact	11 (1%)	76 (4%)
Refused	65 (5%)	96 (5%)
Interviewed	1203 (91%)	1579 (84%)
Community	1124	1500
Institution	79 (6%)	79 (4%)

Table 3.4: Numbers identified and interviewed in 1981 and 1988 surveys by sex, birth cohort, age when survey population drawn and place of residence at interview

Cohort	Birth year	Age in years	Number interviewed in	
			Community	Institution
Men				
0	<=1884	96+ (1981)	0	0
		103+ (1988)	0	0
I	1885-1891	89-95 (1981)	12	2
		96+ (1988)	0	0
II	1892-1898	82-88 (1981)	69	4
		89-95 (1988)	11	0
III	1899-1905	75-81 (1981)	287	6
		82-88 (1988)	134	5
IV	1906-1912	68-74 (1981)	0	0
		75-81 (1988)	378	8
Women				
0	<=1884	96+ (1981)	2	5
		103+ (1988)	0	0
I	1885-1891	89-95 (1981)	49	25
		96+ (1988)	10	3
II	1892-1898	82-88 (1981)	186	25
		89-95 (1988)	50	16
III	1899-1905	75-81 (1981)	519	12
		82-88 (1988)	294	29
IV	1906-1912	68-74 (1981)	0	0
		75-81 (1988)	623	18

Table 3.5: **Probability of survival at yearly intervals from interview by sex, age group and year of survey**

	Female						Male					
Time from interview (yrs)	**75-81 years**		**82-88 years**		**89-95 years**		**75-81 years**		**82-88 years**		**89-95 years**	
	1981	**1988**	**1981**	**1988**	**1981**	**1988**	**1981**	**1988**	**1981**	**1988**	**1981**	**1988**
0	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
1	0.93	0.95	0.88	0.88	0.68	0.79	0.91	0.94	0.83	0.82	0.65	0.93
2	0.87	0.90	0.79	0.76	0.59	0.55	0.83	0.87	0.61	0.65	0.48	0.62
3	0.80	0.83	0.66	0.68	0.42	0.45	0.78	0.76	0.49	0.54	0.14	0.49
4	0.74	0.77	0.52	0.58	0.32	0.39	0.70	0.70	0.32	0.39	0.14	0.36
5	0.67	0.73	0.49	0.49	0.21	0.34	0.63	0.64	0.26	0.34	0.14	0.36

Table 3.6: Demographic characteristics of the subjects interviewed in their own homes

	Women				Men			
	1981 (n=756)		1988 (n=977)		1981 (n=368)		1988 (n=523)	
	%	(n)	%	(n)	%	(n)	%	(n)
Age								
75-81	69	(519)	64	(623)	78	(287)	72	(378)
82-88	25	(186)	30	(294)	19	(69)	26	(134)
89-95	6	(49)	5	(50)	3	(12)	2	(11)
96-101	0	(2)	1	(10)	0	(0)	0	(0)
Social Class								
I-II	20	(155)	23	(221)	26	(94)	25	(133)
III	48	(361)	54	(531)	47	(174)	56	(294)
IV-V	28	(211)	19	(186)	24	(90)	17	(87)
Missing/Forces	4	(29)	4	(39)	3	(10)	2	(9)
Living arrangements								
Married	23	(176)	21	(207)	68	(252)	61	(319)
Not married, lives alone	58	(435)	60	(591)	20	(75)	29	(150)
Not married, lives with others	19	(145)	17	(163)	11	(41)	8	(43)
Missing	0	(0)	2	(16)	0	(0)	2	(11)
Accommodation								
Wardened/ Sheltered Housing	11	(86)	16	(157)	4	(15)	8	(41)
Other housing, no inside stairs	28	(212)	25	(248)	28	(103)	28	(146)
Other housing, with inside stairs	59	(445)	58	(569)	66	(244)	64	(335)
Other/missing	2	13	0	(3)	2	(6)	0	(1)

Figure 3.1: Melton Mowbray

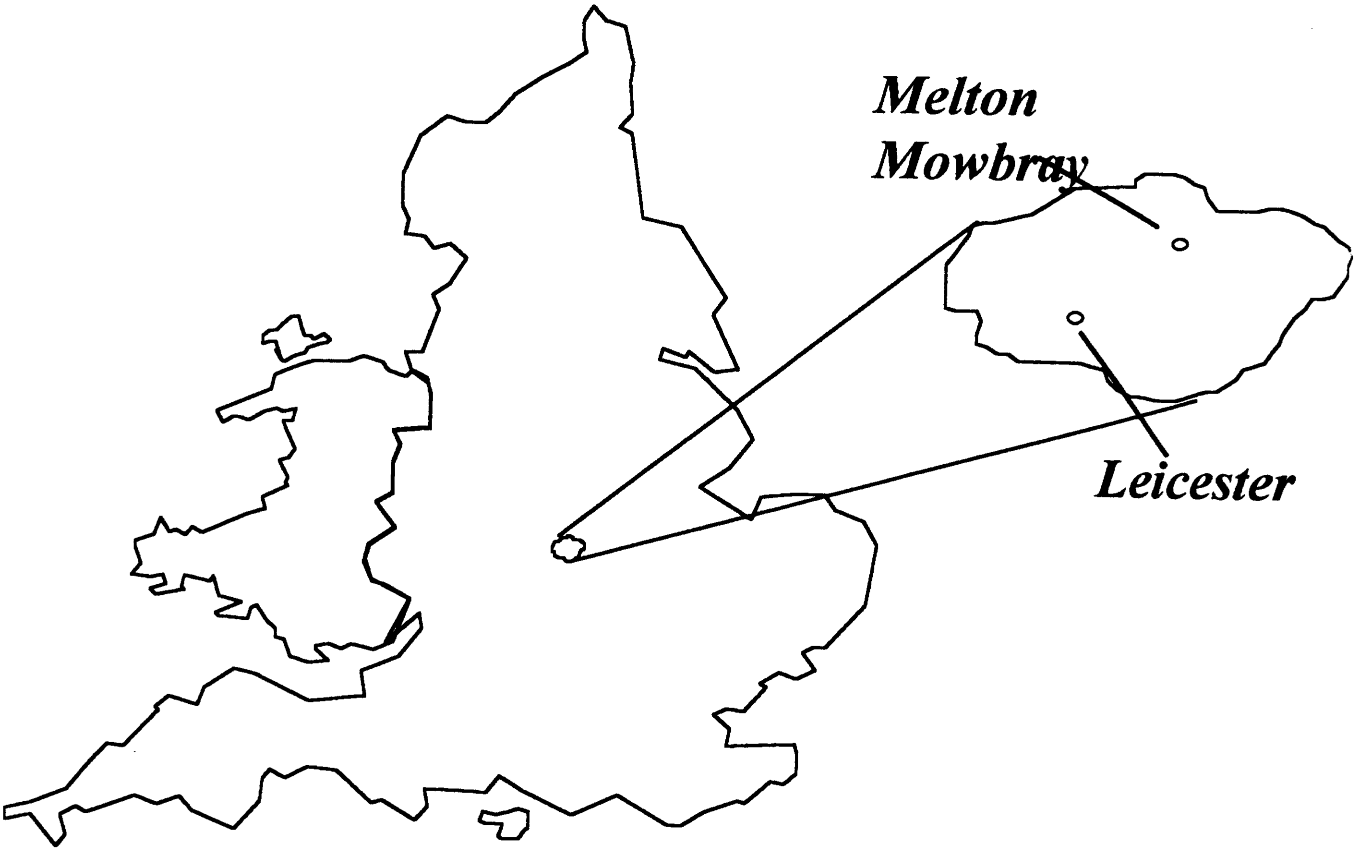


Figure 3.2: Age-sex distribution of males in Melton Mowbray District and Great Britain, 1981

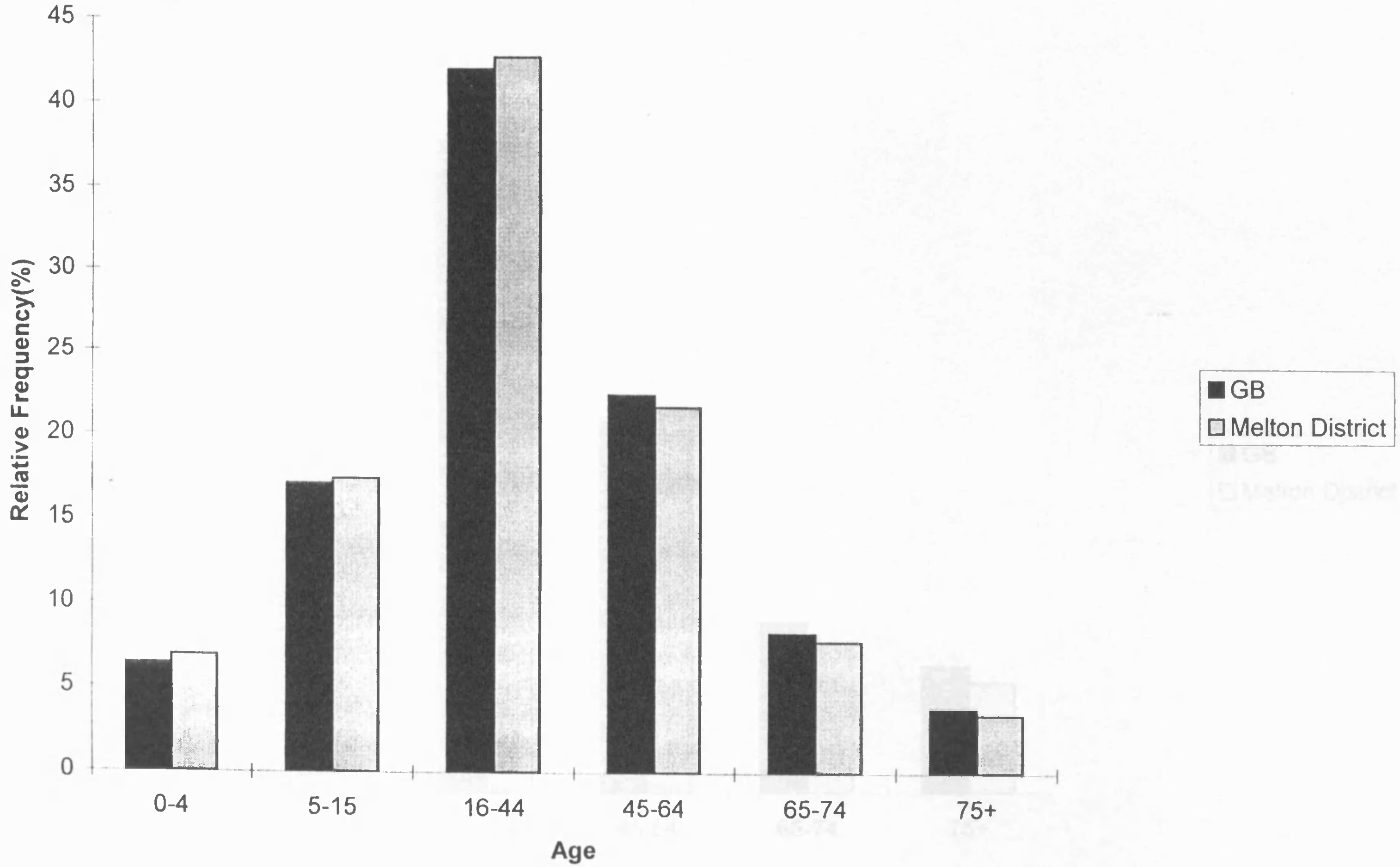


Figure 3.3: **Age-sex distribution of females in Melton Mowbray District and Great Britain, 1981**

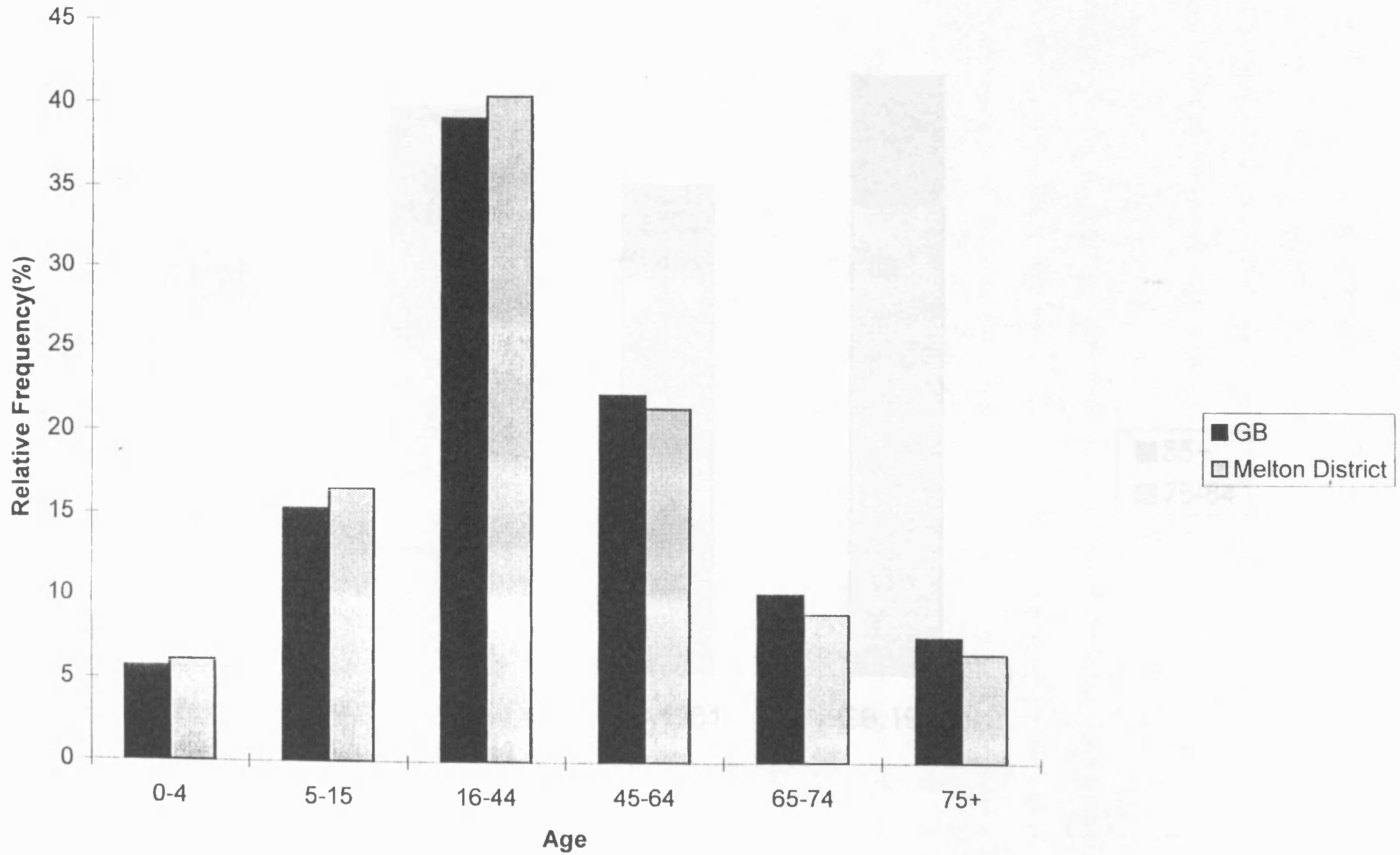
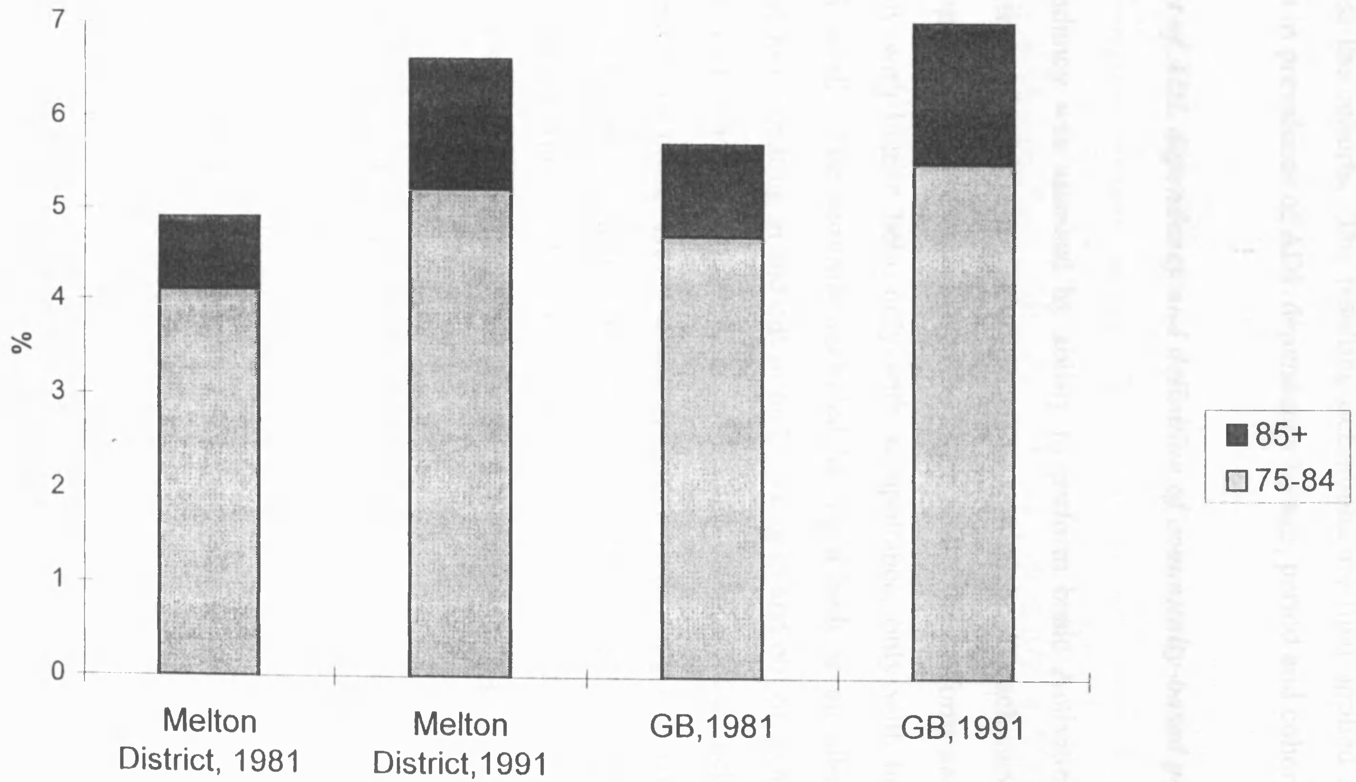


Figure 3.4: Percentage of population aged over 75 years: Melton District and Great Britain, 1981 and 1991



4. TRENDS IN ADL DEPENDENCY

This chapter begins with description of the methods used to assess dependency, and investigation of psychometric properties of an ADL scale developed by Jagger, Clarke and Davis (1986), with the objective of defining consistent thresholds for ADL dependency across the cohorts. The resulting definitions are then applied in order to investigate trends in prevalence of ADL dependency by age, period and cohort.

4.1 Measurement of ADL dependency and definition of community-based population

Functional dependency was assessed by ability to perform basic Activities of Daily Living, independently of help from another person or appliance. At each survey and for each activity, respondents were categorised by their ability to perform each activity without help, only with human help, only with an appliance, only with help and an appliance, or not at all. The activities included having a bath or an all-over wash, dressing, using the toilet, getting in and out of bed, getting in and out of a chair, eating, and mobility around the house. In 1988, an additional category was included, with participants being asked whether they had any difficulty performing the ADL, prior to being asked about dependency. There were also some changes in definition of activities between the surveys, relating to dressing and using the toilet. Full details of the activities included and wording of questions are given in Appendices 4A and 4B.

People interviewed in institutions (n=79 at both surveys), were excluded from the main analyses because measures of health status may not be comparable for people interviewed at home and in institutions. This reservation applies to all three health measures examined for in Chapters 4 to 7. For dependency, there are systematic differences by setting in availability of human and mechanical help, and there may also be differences in willingness to report dependency. The question relating to self-perceived health was not asked of people interviewed in institutions, and imputation was not straightforward, as it could not be assumed that self-perceived health for people interviewed in institutions was always poor (Fillenbaum, 1979). In the case of GP use for patients in institutions, the decision to contact a GP would in many cases be taken by staff, rather than the patient or a friend or relative, suggesting that different models for GP contact are needed in the two settings. Focusing upon people interviewed at home throughout produced a consistent and reasonably homogeneous study population. It was impossible to avoid potential for bias due to change in the rate of institutionalisation, particularly affecting women in the oldest age groups, but sensitivity of the conclusions to this source of bias was assessed after the main analyses.

Prevalence of dependency and difficulty in ADL are summarised in Table 4.1. Bathing was the ADL in which the greatest number were dependent, with over one third of the population using help in some form. The least frequent dependency was in eating, with only a small minority receiving help. The proportion of older people dependent in mobility around the house, transfers and bathing decreased slightly between 1981 and 1988, whilst there was no change in prevalence of dependency in dressing and eating. The proportion dependent in eating in this community-based population is so small that there is little prospect of observing a significant decrease. There was a marked decrease in dependency in getting to and from and using the toilet, most probably due to differences in question wording; in 1981 specific reference was made to using the toilet at night, whereas in 1988 the item referred to "getting to and from and using the toilet". As the decrease in prevalence of dependency in using the toilet was probably artifactual, this activity was omitted in subsequent analyses.

The proportion of elderly people independent in the activities of mobility around the house, getting in and out of a chair, getting in and out of bed, dressing and eating, increased between surveys, from 77% to 80% in the female population, but declined from 83% to 82% amongst the males (Table 4.2). In the female population the prevalence of incontinence increased, whilst amongst the males there was a marginal decline in prevalence. Because assessments of cognitive ability were not available for 50 women and 12 men interviewed in 1981, it was not possible to draw any firm conclusion about trends in levels of cognitive impairment.

Cross-sectional analysis of individual Activities of Daily Living in this population has already been published by Jagger, Clarke and Clarke (1991). Using log-linear models to adjust for age and sex, and defining independence as the ability to perform an activity unaided by appliances or human help, they reported no significant change in dependency levels for mobility around the home, feeding, or incontinence of urine or faeces, but statistically significant reductions in dependence levels for getting in and out of a chair and in and out of bed, dressing, bathing and getting to and from and using the toilet. Overall improvement in levels of disability for the cohorts surveyed in 1988, compared to their precursors in 1981, was attributed to the effect of health and social reforms in the early part of this century. The analysis investigated period, but not cohort effects, and no attempt was made to interrelate dependency in individual ADL. The present work developed the earlier analysis, firstly investigating interrelationships between the ADL items, secondly using cohort comparisons to investigate trends in functional dependency, and thirdly by allowing trends to vary by gender.

4.2 Psychometric properties of the ADL scale and implications for the analysis of trends

Aside from the underlying disease burden, and changes in the population denominator, change in disability prevalence may be due to measurement error or differences in measurement procedure (Jette, 1994; Weiner et al, 1990). In particular, prevalence varies according to ADL items included, and according to the threshold adopted for impairment, which may be defined by difficulty performing the ADL, receipt of help from another person, or receipt of help from another person or appliance, the threshold used here. The predictive validity of ADL dependency in the present dataset has been confirmed with respect to death (Spiers, Jagger and Clarke, 1996) and decline in function (Jagger, Spiers and Clarke, 1993). However, the possibility of measurement error remains open. Recent research, reviewed by Rodgers and Miller (1997), has highlighted potential for error in the measurement of ADL. Proxy respondents have been found to report considerably more ADL limitation than self-respondents. Mathiowetz and Lair (1994) found that improvement in ADL was more frequent where the assessment was by self-report, rather than proxy at both baseline interview and one year follow-up. They also found some indication of variation by interviewer characteristic upon the proportion with improvement. Both of these measurement effects were associated with the proportion assessed as improving in functional capacity, but not in the proportion whose capacity declined.

Other sources of error, such as between-interviewer variability, cannot be assessed in the linked cross-sectional design, although steps were taken in the training of interviewers to minimise this (Jagger, Clarke and Clarke, 1991). However, there are some differences in wording of questions between the two surveys, and their effect is unknown. Systematic effects may also result from the order in which questions are asked; for example placement of two closely related activities together in the order of questioning may have an effect upon responses to the second question. Change in the order of the ADL items between the surveys means that these effects are allowed for in this analysis.

An ADL scale was developed using responses from the 1981 survey by Jagger, Clarke and Davis (1986). Using Principal Components Analysis and Guttman scaling, they concluded that the items of mobility, transfers to and from a chair, transfers to and from bed, dressing and eating, formed an internally consistent scale with good scalability and reproducibility. The present analysis incorporated data from both cross-sectional surveys, and made use of Mokken Scale Analysis (Mokken, 1971), a variation of Item Response Analysis (Fischer and Molenaar, 1995), to compare the structure of the scale across the two surveys, with the aim of developing a definition of ADL dependency that has reasonably consistent measurement properties across surveys and cohorts. The objective was to establish an ADL hierarchy that taps single underlying dimension of disability.

The assumption of a single underlying dimension was first established using Principal Components Analysis (Everitt and Dunn, 1991). It was confirmed that incontinence of urine and faeces together represent a different dimension from the ADL of transferring, mobility about the house, dressing and eating. This conclusion has already been reported for the 1981 survey (Jagger Clarke and Davis, 1986). Although incontinence was included as a ADL by Katz (Katz et al, 1963; Katz and Akpom, 1976), more recent population studies have omitted incontinence from the list of basic ADL (for example Branch et al, 1984; Manton and Stallard, 1991; Strawbridge et al, 1996). Results from Principal Components Analysis are given in Appendix 4C.

The ADL of mobility about the house, transferring, dressing and eating, generally followed a hierarchical model, with activities ranked in order of difficulty, so that people who have help with an easy item, by and large, also have help with the more difficult ones. For example, it is very rare to find someone who needs help with eating but is able to get around the house independently. The underlying assumption is that people lose the ability to independently perform ADL sequentially, in an order corresponding both with severity of disability and inversely with difficulty of the challenge posed by the individual ADL. This hierarchical assumption was hypothesised by Katz in first developing an ADL scale (Katz et al, 1963) and has been supported in other work (Kempen, Myers and Powell, 1995; Spector and Fleishman, 1998). If the physiological processes culminating in disability onset remain unchanged across cohorts, then the order of ADL should be time invariant. This assumption was examined initially through crosstabulations, and further by comparing item response analyses from ADL responses in 1981 and 1988 using Mokken Scale Analysis with the aid of the package MSP (ProGAMMA, 1994). These analyses are described in detail in Appendix 4D.

Both the Mokken Scale Analysis for 1981 and the Principal Components Analyses indicated that the activity of bathing should be treated as a separate dimension of disability from incontinence or the other physical activities, so this activity was considered separately in subsequent analyses. Failure of bathing to scale consistently with the other ADL may be due to inclusion of stripwash as an allowable alternative in the question for this ADL. The Mokken Scale Analysis supported an ordinal hierarchical scale for basic ADL at both surveys, with dependency in mobility about the house, transfer to and from a chair, transfer to and from bed, dressing, and eating, as thresholds for successively increasing degrees of dependency. Transfers to and from a chair and bed, and dressing, all index dependency at a similar level of severity of limitation. This order is consistent with that of Katz (Katz and Akpom, 1976), with respect to transfers and eating, but differs with respect to the location of dressing. In the Katz hierarchy, dressing comes before transfers, and indexes less severe disability (Table 4.3). However, the Katz hierarchy is based on human help as a threshold, so that earlier location of dressing reflects the fact that use of appliances to assist with dressing is rare. The Katz hierarchy is supported by analysis of the US National Long-Term Care Survey by Spector and Fleishman (1998), again using receipt of human help as the threshold for ADL impairment. In secondary analysis of three surveys of elderly populations by Spector et al (1987), the Katz hierarchy is supported in two surveys where human help is used as a threshold, but in a third where no distinction was drawn between human and mechanical help, the order of dressing and transfers is reversed, consistent with the present study. Thus, hierarchies are consistent across populations studied, but vary with threshold used to define impairment. Other studies using difficulty as a threshold for disability, have produced less consistent results with regard to the ADL hierarchy (Dunlop, Hughes and Manheim, 1997; Kempen et al, 1996; Kempen, Myers and Powell, 1995).

The Mokken Scale and Principal Components Analysis were repeated for subgroups by sex, whether the participant was living alone, and whether their accommodation had inside stairs. There was some indication that dependency in the activity of dressing, where most help received is from another person, is sensitive to availability of human help, but this effect was small. There was no substantial evidence that the hierarchy of ADL varies across survey periods, and comparisons of disability prevalence between cohorts measured at comparable ages at different occasions using the five-item scale (based upon the ADL of mobility around the house, getting in and out of a chair, getting in and out of bed, dressing and eating) were supported. This scale is used in subsequent analyses to assess trends in disability at two different levels of severity, from moderate (receiving human or technological help with mobility about the house) to more severe (receiving human or technological help with transfers).

4.3 Cohort analysis: methodology

The primary analysis of trends in ADL dependency includes elderly people interviewed in their own homes, with male and female populations analysed separately. The threshold for dependency in the main analysis is mobility around the house, so that a participant is classified as dependent if they have help from another person or appliance with any of five ADL: mobility about the home, getting in and out of bed, getting in and out of a chair, dressing and eating. The analysis was repeated with mobility around the house excluded, effectively adopting transfer to and from a chair as the threshold for rather more severe disability. Finally, prevalence of incontinence in at least one of urine and faeces, and prevalence of dependency in bathing were modelled separately. Prevalence of ADL dependency are tabulated by sex, cohort and period of survey with denominators including all subjects interviewed at home. To better illustrate differences in prevalence between cohorts, the prevalence are also presented graphically.

Statistical modelling was used to determine whether observed age, cohort and period differences are sufficiently large to be attributable to systematic effects other than chance. Models for the logodds of ADL dependency are fitted by maximum likelihood estimation, using GLIM4 (Royal Statistical Society, 1992), and assuming independent binomial errors, following the approach outlined in Chapter 2. For the calculation of confidence intervals and significance tests to investigate generalisability, the population is assumed to be a pseudo-random sample from the population aged over 75 years of England and Wales. Statistical significance of age, period and cohort differences and interactions was assessed using the likelihood-ratio test statistic, G^2 (Aitken et al., 1989). Overall fit of the models is assessed using Pearson's Chi-squared Statistic.

Coding details for outcome and explanatory variables are given in Table 4.4. Initial modelling established that the data could be accounted for with good fit by two-factor age-cohort or age-period logit models, these models being viewed as frameworks which account for the aggregated data observed, and no attempt is being made to choose empirically between models with good fit. Differences in prevalence between subgroups were quantified by estimation of odds ratios. Details of the calculation of odds ratios and 95% confidence intervals are given in Appendix 4E. Very small numbers of survivors in the eldest cohorts make reliable estimation impossible. Analysis and conclusions are therefore based on the three cohorts born from 1892-1898, 1899-1905 and 1906-1912 (aged 68 to 88 on 31.12.80) for men and women, together with the cohort born from 1885-1891 (aged 89-95 on 31.12.80) for the female population but not for the males, as only 12 men from this cohort were interviewed at home in 1981.

4.4 Prevalence of dependency in activities of daily living

The proportion of elderly people dependent in ADL is summarised by sex, cohort and survey in Table 4.5. In 1981, men were consistently less likely than women to be dependent in ADL across all age groups. However, by 1988 this gender gap had narrowed, with similar prevalence of ADL dependency for men and women in cohorts born in 1899-1905 and 1906-1912. Prevalence of ADL dependency increased with age of the population studied. This may be seen more clearly in Figures 4.1 and 4.2, which show prevalence of dependency by age, cohort and survey for women and men respectively. Age midpoints for the cohorts in 1981 and 1988 are ranged on the horizontal axis, and prevalence are plotted on the vertical scale. Dotted lines join the prevalence for the birth cohorts observed in 1981, and the prevalence for survivors of the same birth cohort in 1988. The increase in prevalence between points joined by dotted lines represents an estimate of the intra-cohort difference or longitudinal ageing effect, net of the effects of mortality, institutionalisation and migration. The gradient with age is somewhat steeper for men than for women, with the prevalence generally being a little lower for men. Institutionalisation has little effect in the male population, but in the female population the numbers institutionalised at ages over 80 years are quite high, so that the longitudinal ageing effect in Figure 4.1 somewhat understates the increase in prevalence when all in the community-based population in 1981 are followed-up (Figure 4.3).

Inter-cohort differences are represented in Figures 4.1 and 4.2 by vertical distances between prevalence in 1981 (diamonds) and prevalence in 1988 (squares). There is only limited evidence of trends across cohorts or surveys. For women, there are improved levels of functional capacity for the women born in 1906-1912, compared to their precursors. Seventeen percent of women aged 75-81 years were dependent when interviewed in 1981, as compared to 13 percent of the succeeding cohort interviewed at comparable ages in 1988. However, dependency levels for women born in 1899-1905 and 1882-1898, when interviewed at age 82-88 years, were stable at 30 percent. The estimated odds ratios and confidence intervals for prevalence of dependency are given in Table 4.6. Although odds of dependency in the female population are elevated for earlier cohorts relative to the cohort born in 1906-1912, this effect does not reach statistical significance.

There is no evidence of intercohort differences in the prevalence of ADL dependency amongst the male population (Figure 4.2). Men aged 75-81 years in 1988 have only a slightly lower prevalence of ADL dependency than their precursors surveyed in 1981. The cohort born in 1899-1905 has experienced a rather steep increase in the proportion dependent between 1981 and 1988 and disability prevalence peaks with this cohort. However, aside from the significant ageing effect, the vertical differences in Figure 4.2 are well within the margins allowed for sampling error, regardless of whether they are modelled as period or cohort effects (Table 4.6). The proportion of men living alone increased from 20% in 1981 to 29% in 1988, but there is no evidence that this demographic shift has influenced the (lack of) trend in dependency. Men living alone were somewhat less likely than those living with others to be dependent in ADL, but estimates of period and cohort differences were largely unchanged when a covariate to allow for this difference was included in the model for ADL dependency (Appendix 4F).

The analysis was repeated for prevalence of more severe disability, with dependency in ADL defined as dependency in at least one of the four ADL of transfer to and from bed, transfer to and from chair, dressing and eating. The results in the male population were not noticeably altered, but the conclusions for women were qualitatively different (Table 4.7), with statistically significant evidence of drift (secular trend attributable either to cohort or period), with the newer cohorts having lower prevalence of dependency. From Figure 4.4 it can be seen that the intercohort differences are similar across age groups, and so may be consistent with a period effect, perhaps related to availability of help. For example, decreased levels of dependency could be due to the increase in the proportion of women living alone and managing without human help. This hypothesis was investigated by fitting further models, with living alone included as a covariate. As expected, elderly women living alone were less likely to be classified as dependent in ADL, using the four-item dependency scale (odds ratio 0.51; 95% confidence interval 0.37 to 0.70). However, this association is independent of secular trends (Appendix 4F). The drift towards lower prevalence was observed both for women living alone, and for those living with others, and there was no evidence of an interaction between period and living alone. The possibility that less help with transfers at the 1988 survey may be due to fixed supply of appliances was investigated, but the reduction in the proportion receiving help is compounded from both reduction in the proportion using appliances, and reduction in the proportion in receipt of human help.

For women, trends in dependency in the activity of bathing were broadly in line with the results for the other ADL (Tables 4.8 and 4.9). Prevalence peaked in the cohort born 1899-1905, and was significantly higher in this cohort than in the cohort born in 1906-1912. For men, however, trends in prevalence of dependency in bathing were rather different from the results for the other ADL, with clear evidence of a secular trend with time, with lower prevalence of dependency in newer cohorts (Figure 4.5). Changes in prevalence of dependency in bathing may also reflect changes in availability of amenities such as showers. Because there were relatively small numbers who are incontinent of urine or faeces, there is limited evidence on trends. The analyses suggest that the prevalence of incontinence increased with age, at least for women. For women, there was also an increase in the prevalence of incontinence across succeeding cohorts, (Table 4.10), but this was not statistically significant. For men, there was no evidence of any trend.

Information on period of residence in the area and distance moved into the area was available from the 1988 survey. In-migrators were defined as those who had been resident in the area 10 years or less (the categories in the questionnaire did not allow for the seven-year time period between the surveys) and had moved a distance of more than five miles. Ninety-three people (including the 79 people in institutions) had missing data and 188 in-migrators and 1298 non-migrators were identified. When the primary analysis, with dependency defined as dependent in at least one of mobility, transfer to and from bed, transfer to and from chair, dressing and eating, was repeated with only non-migrators present in 1988, there were no substantial changes in the conclusions drawn.

4.5 What can be concluded about trends in ADL dependency?

When assessed longitudinally, levels of functional disability increased quite steeply with age, despite selection effects of mortality and institutionalisation. Amongst the female population, there is some evidence of better health in the latest cohort, with women born in 1906-1912 having lower prevalence of ADL dependency than their forerunners, though whether this effect reaches statistical significance depends upon the threshold used to define dependency. The intercohort differences were largest in the case of more severe disability, defined by receipt of human or technological help with transfers. This is despite declining rates of institutionalisation, which might have suggested that more severely disabled women were remaining within the community.

For men, intercohort differences in prevalence of ADL dependency were less, and smaller numbers make interpretation difficult, but levels of disability in old age may have peaked with the cohort born in 1899-1905. However, if dependency in bathing is considered, then there is clear statistically significant evidence of reduced levels of dependency in the newer male cohorts. This rather different result may reflect use of a different threshold, capturing milder disability than problems with transfers and walking, or alternatively there may be demographic or cultural effects. There is no support for the hypothesis that levels of help may have declined because of the increased proportions of men in the newer cohorts who are widowers, but there may be intercohort differences in willingness of men to accept help with bathing.

The above conclusions have been drawn within an age-cohort framework, under which disability is attributed to underlying impairments, which in this age group are likely to arise from longstanding medical conditions associated with accumulated exposures and wear and tear over a lifetime, so that the prevalence of disability reflects cohort experience. This framework discounts period differences, and may be used to account for cohort differences in levels of intrinsic disability. However, intrinsic disability is distinguished from ADL dependency by Verbrugge (1990), who points out that ADL dependency does not measure disability directly, but rather the efforts that people make to accommodate to their intrinsic disabilities. Verbrugge suggests using difficulty performing ADL as a more direct measure of disability, but this measure is not considered here, as difficulty was not available for the 1981 survey. Whilst operation of substantial period effects upon levels of intrinsic disability seems implausible, the same is not true of the efforts which people make to accommodate to their disability, as these are more readily influenced by factors in the immediate environment such as availability of help. The results for ADL dependency may also reflect such period differences.

Including help from an appliance as well as help from another person in the definition of dependency goes some way towards reducing sensitivity to availability of a helper within the household. This is confirmed by the independence of trends in dependency and household composition in this population. However, the measure of ADL dependency remains sensitive both to availability of appliances, and to changes in the type and quality of technological help available. The primary analysis defined dependency in the majority of cases by receipt of help with mobility, which was generally from an appliance, rather than another person. This analysis should be robust, as it is hard to envisage substantial period differences in availability of walking sticks and frames. On the other hand, the drift effect observed for women when mobility was excluded from the list of ADL used to define dependency may be attributable to changes in availability of, rather than need for, assistance with transfers to and from bed. It is also possible that, because the newer cohorts were more affluent, older people within these cohorts may have been more likely to acquire or adapt furniture in order to accommodate to their disabilities.

Finally, the possibility of measurement error must be taken into account. Difficulty in performing the ADL was included as a possible response category in the 1988 questionnaire, but not in 1981. This may have had a systematic effect upon reporting of dependency common to all the ADL. For example, prompting for difficulty first may have assisted recall of assistance received. Such a shift might be expressed as a period effect common across all ADL, not detectable by the item response analysis.

The results for disability prevalence calculated using different thresholds suggest that not only prevalence, but also trends, may be sensitive to the methods used to define dependency. This is consistent with differences in trends reported in large population-based surveys in the US. The results underline the need for careful and consistent wording of ADL items, and a precise approach to ADL measurement, such as that adopted by Rodgers and Miller (1997).

Given reservations about the quality of ADL measurement, specifying the magnitude of trends in ADL dependency is difficult, but broad conclusions about the existence and direction of trends may be drawn. The analyses are reasonably consistent in suggesting either a small decrease or no change in disability prevalence. This picture of an unspectacular but, if anything, decreasing trend in prevalence of ADL dependency over the 1980s is consistent with results from the GHS (Bone, 1995), notwithstanding that dependency was defined in the GHS as having help from another person. The conclusion is also broadly similar to results from the US (Crimmins, Saito and Reynolds, 1997; Manton, Stallard and Corder, 1998). There is some indication of a small decrease over the 1980s in the age-specific prevalence of very severe disability requiring personal care from another person, or of quite severe disability requiring use of help from a person or appliance with ADL. The trend therefore is towards an elderly population that is slightly more functionally able, age for age. However, it is by no means certain that these trends would be replicated in an analysis of milder disability, indexed by inability to perform IADL.

4.6 Summary

A five item ADL scale, including activities of mobility about the home, getting in and out of bed, getting in and out of a chair, dressing and eating, was found to have reasonably good scale properties, and to support a hierarchy of ADL that was consistent at both surveys. Dependency was defined by use of human or technological help in at least one of these five ADL. Two-factor age-cohort and age-period models were fitted to compare prevalence of ADL dependency between birth cohorts surveyed at comparable ages. The cohorts included in the analysis were born in 1906-1912, 1899-1905 and 1892-1898, together with relatively small numbers born in 1885-1891.

As the cohorts aged, prevalence of dependency in ADL increased, and was generally higher for women. For men, dependency prevalence may have peaked in the cohort born in 1899-1905, but there was no statistically significant evidence of intercohort differences. In women, the magnitude of trends depends upon the threshold used to define dependency, with age-specific prevalence of dependency defined by use of help to get about the house being unchanged across cohorts, but age-specific prevalence of dependency in transfers to and from bed being lower in 1988 than in 1981. It is unclear whether this difference is a period effect due either to measurement effects or changes in availability of help, or whether there is a difference in intrinsic disability prevalence between cohorts. It is concluded that prevalence of dependency in the cohort born 1906-1912 at age 75-81 years is at least no higher than in the preceding cohorts.

Table 4.1: Categories of dependency in physical activities amongst older people interviewed at home: percentage (numbers in parenthesis)

	Bed		Chair		Mobility		Bathing		Dressing		Eating		Toilet	
	1981	1988	1981	1988	1981	1988	1981	1988	1981	1988	1981	1988	1981	1988
Independent	-	88	-	87	-	78		49		77		97		79
No difficulty		(1324)		(1300)		(1172)		(733)		(1160)		(1459)		(1178)
Independent	-	7	-	8	-	4		18		16		2		3
With difficulty		(112)		(114)		(65)		(276)		(245)		(26)		(39)
All	**93**	**95**	**90**	**95**	**81**	**82**	**64**	**67**	**94**	**93**	**99**	**99**	**69**	**82**
Independent	**(1043)**	**(1436)**	**(1008)**	**(1414)**	**(915)**	**(1237)**	**(718)**	**(1009)**	**(1052)**	**(1405)**	**(1108)**	**(1485)**	**(777)**	**(1217)**
Uses Aids	3	2	8	4	16	16	18	13	1	1	0	0	29	18
	(36)	(27)	(90)	(60)	(185)	(237)	(206)	(200)	(11)	(11)	(1)	(2)	(325)	(270)
Uses help	3	2	1	1	1	0	11	14	4	5	1	1	0	1
	(33)	(26)	(15)	(14)	(8)	(4)	(127)	(203)	(50)	(73)	(12)	(10)	(3)	(10)
Uses help and	1	0	0	1	1	1	5	5	0	0	0	0	1	0
aids	(9)	(6)	(5)	(8)	(7)	(15)	(61)	(73)	(0)	(4)	(1)	(0)	(13)	(2)
Does not	0	0	1	0	1	0	1	1	1	0	0	0	1	0
Perform	(2)	(4)	(6)	(3)	(9)	(6)	(12)	(14)	(10)	(6)	(1)	(1)	(6)	(0)
All	**7**	**4**	**10**	**6**	**19**	**17**	**35**	**33**	**6**	**6**	**1**	**1**	**31**	**19**
Dependent	**(80)**	**(63)**	**(116)**	**(85)**	**(209)**	**(262)**	**(406)**	**(490)**	**(71)**	**(94)**	**(15)**	**(13)**	**(347)**	**(282)**
Missing	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	(1)	(1)	(0)	(1)	(0)	(1)	(0)	(1)	(1)	(1)	(1)	(2)	(0)	(1)

Table 4.2: Health characteristics of the study population by gender and survey

	Women				Men			
	1981 (n=756)		1988 (n=977)		1981 (n=368)		1988 (n=523)	
	%	(n)	%	(n)	%	(n)	%	(n)
Number of ADL Dependencies[1]								
Independent	77	(584)	80	(778)	83	(305)	82	(427)
1	9	(70)	12	(120)	8	(30)	10	(51)
2	5	(41)	4	(40)	4	(16)	4	(20)
3+	8	(60)	4	(38)	5	(17)	5	(24)
Missing	0	(1)	0	(1)	-	(0)	0	(1)
Incontinence								
No incontinence	88	(664)	86	(836)	89	(326)	90	(471)
Incontinent of urine or faeces	12	(90)	14	(140)	11	(42)	10	(52)
Missing	0	(2)	0	(1)	0	(0)	0	(0)
Cognitive Impairment								
Information/ orientation score 9-12	90	(678)	93	(907)	95	(348)	95	(498)
Information/ orientation score 0-8	4	(28)	7	(70)	1	(2)	5	(25)
Missing	7	(50)	0	(0)	3	(12)	0	(0)

[1] Dependency defined as receiving human or technological help in any one of mobility about the house, transfer to and from bed, transfer to and from chair.

Table 4.3: Hierarchy of basic ADL by severity of disability in community-based studies of older populations

Threshold for ADL impairment	**Human or technological help**		**Human help**			
Authors	Present Study	Spector, et al	Katz and Akpom	Kempen and Suurmeijer	Spector and Fleischman	Spector, et al
Date of Publication	-	1987	1976	1990	1998	1987
Study Population and sample size	Community-based, Leics., UK	Population-based, Cleveland, US	Various	Community-based, Netherlands	Disabled respondents; US NLTCS	Service-based, US (medicare, medicaid)
	2624	1604		101	2977	2591
ADL Hierarchy:						
Least severe	bathing		bathing		bathing	
disability	mobility[1]	mobility		mobility	mobility	mobility
			dressing	dressing	dressing	dressing
	chair	transfers	transfers	bed	transfers	transfers
	bed			chair		
Most severe	dressing	dressing				
disability	eating	eating	eating	eating/drinking	eating	eating

Note: there is slight variation in item wording; for example mobility may refer to 'getting around the house' or 'moving around inside'

Table 4.4: Coding details for measures included in the cohort analysis

Measure	Code	Definition
Outcome		
ADL Dependency	0 independent	independent in all of:
		mobility about the house, transfer to and from bed, transfer to and from chair, dressing, eating
	1 dependent	uses human help of an appliance for at least one of: mobility about the house, transfer to and from bed, transfer to and from chair, dressing, eating
Explanatory		
Age	78	75-81
	85	82-88
	92	89-95
Cohort	4-level factor	IV (b1906-1912, reference group)
		III (b1899-1905)
		II (b1892-1898)
		I (b1885-1891)
Period	0	Interviewed in 1981(reference group)
	1	Interviewed in 1988

Table 4.5: **Proportion (%) dependent in ADL[1] by sex, age (midpoint of age group), cohort (defined by birth year) and year of survey, respondents interviewed at home**

Cohort (age at 1/12/1980)	Women				Men			
	1981		1988		1981		1988	
	(n)	% dependent	(n)	% dependent	(n)	% dependent	(n)	% dependent
IV (68-74 yrs)	-	-	(623)	13	-	-	(378)	13
III (75-81 yrs)	(519)	17	(294)	30	(287)	14	(134)	32
II (82-88 yrs)	(186)	30	(50)	48	(69)	25	(11)	36
I (89-95 yrs)	(49)	53	(10)	50	(12)	42	-	-
Total	(756)	23	(977)	20	(368)	17	(523)	18

[1] Dependent in at least one of mobility around the house, getting in and out of a chair, getting in and out of bed, dressing and eating.

Table 4.6: Estimated odds ratios of dependency in ADL[1] under age-period and cohort models for men and women separately, 95% confidence intervals (CI) in parentheses

	Model	Covariates	Men OR[2] (95% CI)	Women OR[2] (95% CI)
(1)	Cohort	Cohort IV	1.00	1.00
		Cohort III	1.18 (0.75, 1.83)	1.36 (0.98, 1.87)
		Cohort II	0.78 (0.35, 1.74)	1.40 (0.83, 2.34)
		Cohort I	0.69 (0.15,3.08)	1.77 (0.75, 4.15)
		Age (intracohort)	1.15(1.07, 1.23)	1.11(1.06, 1.16)
		X^2	0.44	0.02
		df	1	1
(2)	Age + Period	1981	1.00	1.00
		1988	1.04 (0.72, 1.49)	0.82(0.64, 1.05)
		Age (cross-sectional)	1.13 (1.08, 1.19)	1.13 (1.10, 1.17)
		X^2	2.7	1.2
		df	3	3

[1] Dependent in at least one of mobility around the house, getting in and out of a chair, getting in and out of bed, dressing and eating.

[2] Odds ratio of dependence:independence in ADL

Table 4.7: Estimated odds ratios of dependence in ADL[1] using four-item scale: age-period and age-cohort models for men and women separately, 95% confidence intervals (CI) in parentheses

Model	Covariates	Men OR[2] (95% CI)	Women OR[2] (95% CI)
Age+Cohort	Cohort IV	1.00	1.00
	Cohort III	1.48 (0.86,2.52)	1.75 (1.16, 2.63)*
	Cohort II	1.18 (0.44,3.14)	2.94 (1.54, 5.60)*
	Cohort I	1.42 (0.24, 8.19)	6.19 (2.21, 17.30)*
	Age (intracohort)	1.08 (0.99,1.17)	1.01 (0.95, 1.07)
	X^2	1.4	0.01
	df	1	1
Age + Period	1981	1.00	1.00
	1988	0.83 (0.53, 1.28)	0.57 (0.41, 0.77)*
	Age (cross-sectional)	1.09 (1.03,1.16)*	1.10 (1.06, 1.14)*
	X^2	3.1	0.4
	df	3	3

[1] Dependent in at least one of getting in and out of a chair, getting in and out of bed, dressing and eating.

[2]Odds ratio of dependence:independence in ADL

Table 4.8: **Proportion (%) dependent in bathing by sex, age (midpoint of age group, cohort (defined by birth year) and year of survey, respondents interviewed at home**

Cohort (age at 31/12/1980)	Women				Men			
	1981		1988		1981		1988	
	(n)	% dependent	(n)	% dependent	(n)	% dependent	(n)	% dependent
IV (68-74 yrs)	-	-	(623)	31	-	-	(378)	19
III (75-81 yrs)	(519)	36	(294)	48	(287)	28	(134)	34
II (82-88 yrs)	(186)	42	(50)	52	(69)	42	(11)	73
I (89-95 yrs)	(49)	49	(10)	70	(12)	50	-	-

Table 4.9: Estimated odds ratios of dependence in bathing : age-period and age-cohort models for men and women separately, 95% confidence intervals (CI) in parentheses

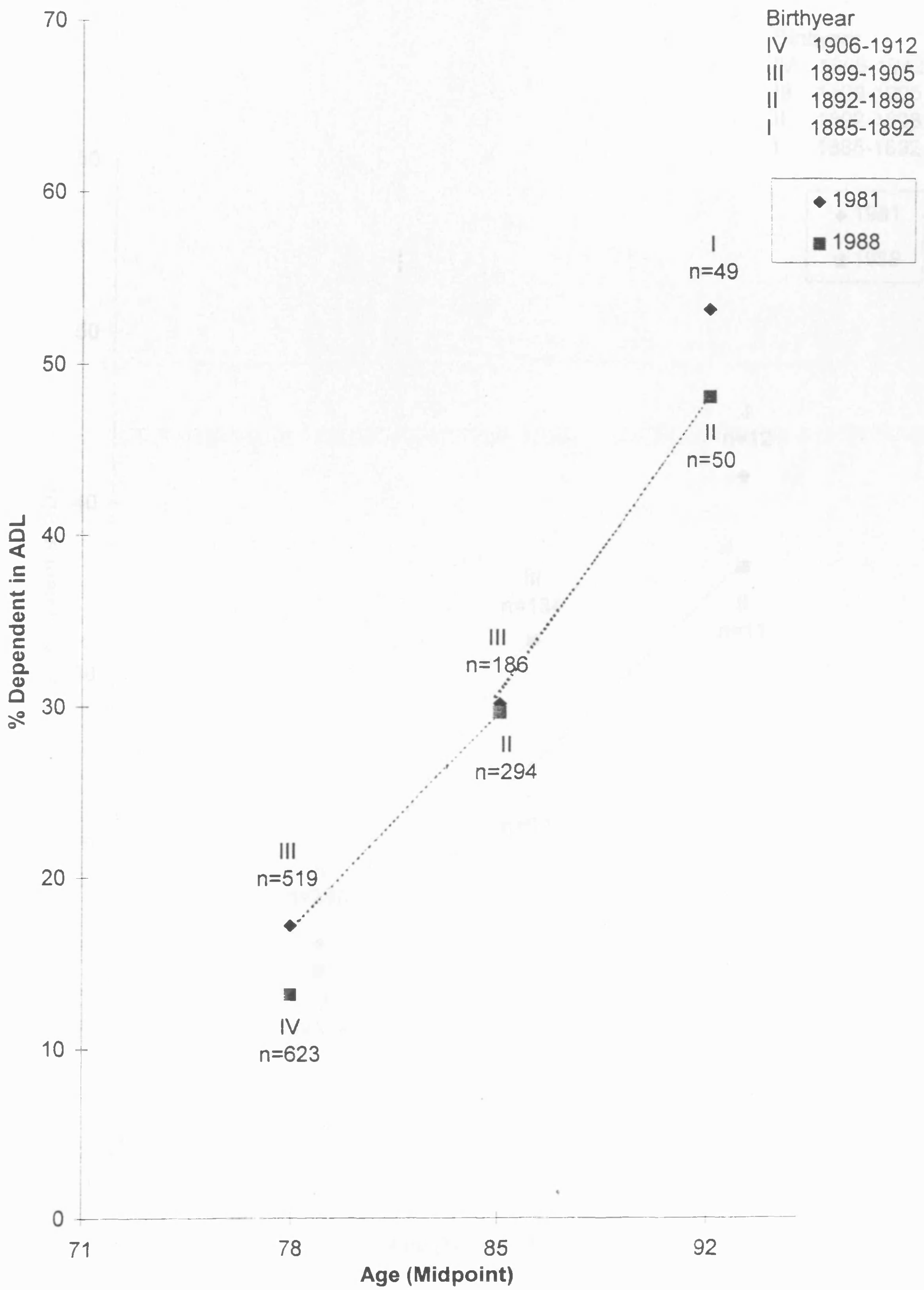
	Model	Covariates	Men OR[1] (95% CI)	Women OR[1] (95% CI)
(1)	Age+Cohort	Cohort IV	1.00	1.00
		Cohort III	1.59 (1.10,2.28)*	1.29 (1.01, 1.65)*
		Cohort II	2.32 (1.15, 4.65)*	0.99 (0.63, 1.57)
		Cohort I	1.91 (0.45, 7.95)	0.83 (0.37, 1.84)
		Age	1.06 (0.99, 1.13)	1.07 (1.03, 1.12)*
		X^2	1.9	0.07
		df	1	1
(2)	Age + Period	1981	1.00	1.00
		1988	0.66 (0.49, 0.90)*	0.93 (0.76,1.14)
		Age	1.11 (1.07, 1.17)*	1.07 (1.04, 1.11)*
		X^2	3.0	6.8
		df	3	3

[1]Odds ratio of dependence:independence in ADL

Table 4.10: **Proportion (%) incontinent in at least one of urine and faeces, by sex, age (midpoint of age group), cohort (defined by birth year) and year of survey, respondents interviewed at home**

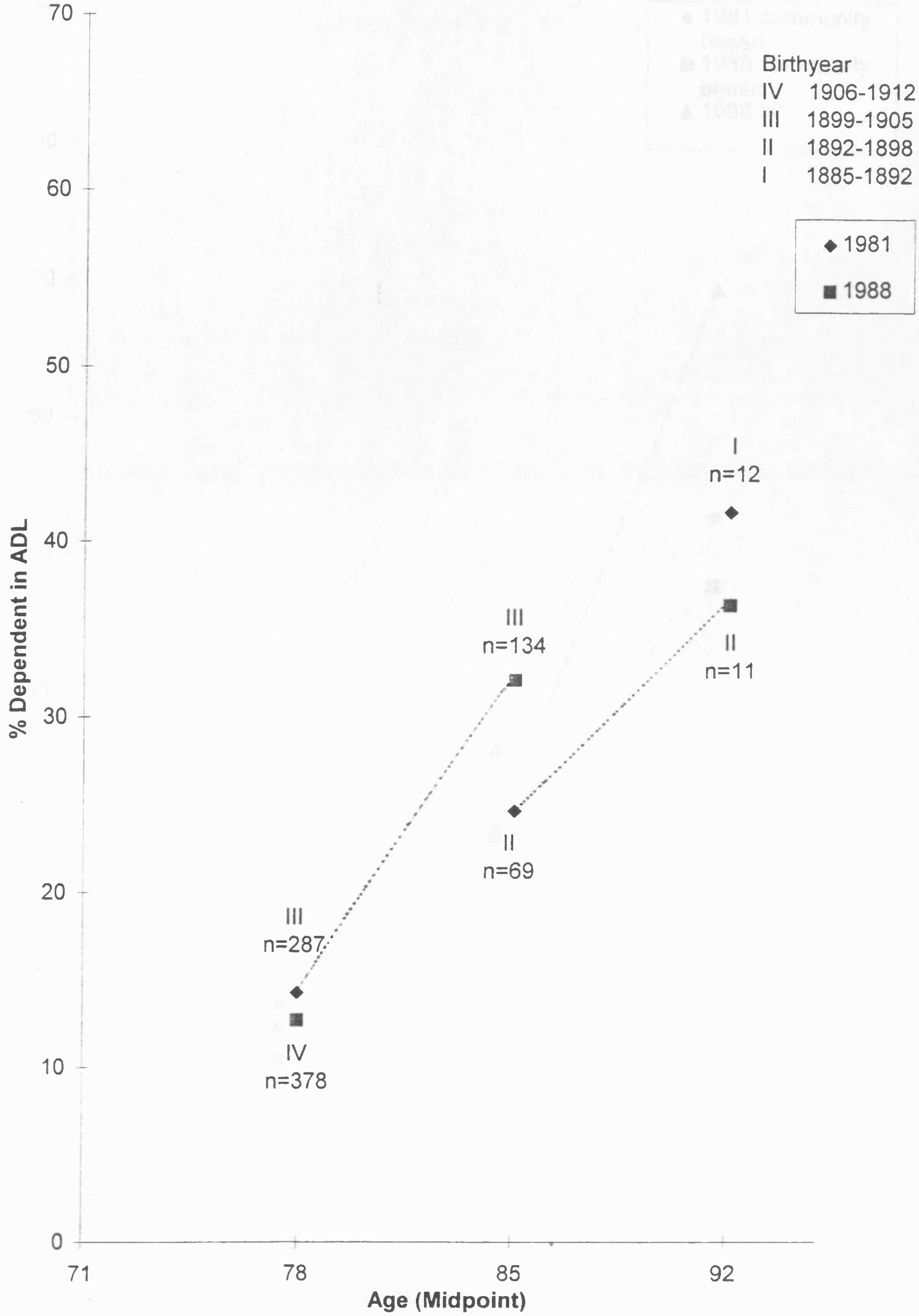
Cohort (age at 31/12/1980)	Women				Men			
	1981		1988		1981		1988	
	(n)	% dependent	(n)	% dependent	(n)	% dependent	(n)	% dependent
IV (68-74 yrs)	-	-	(623)	12	-	-	(378)	9
III (75-81 yrs)	(519)	11	(294)	17	(287)	9	(134)	13
II (82-88 yrs)	(186)	15	(50)	22	(69)	16	(11)	9
I (89-95 yrs)	(49)	16	(10)	40	(12)	33	-	-

Figure 4.1: Percentage of women dependent in ADL and number surveyed, by age (midpoint of age group) and cohort; community-based population



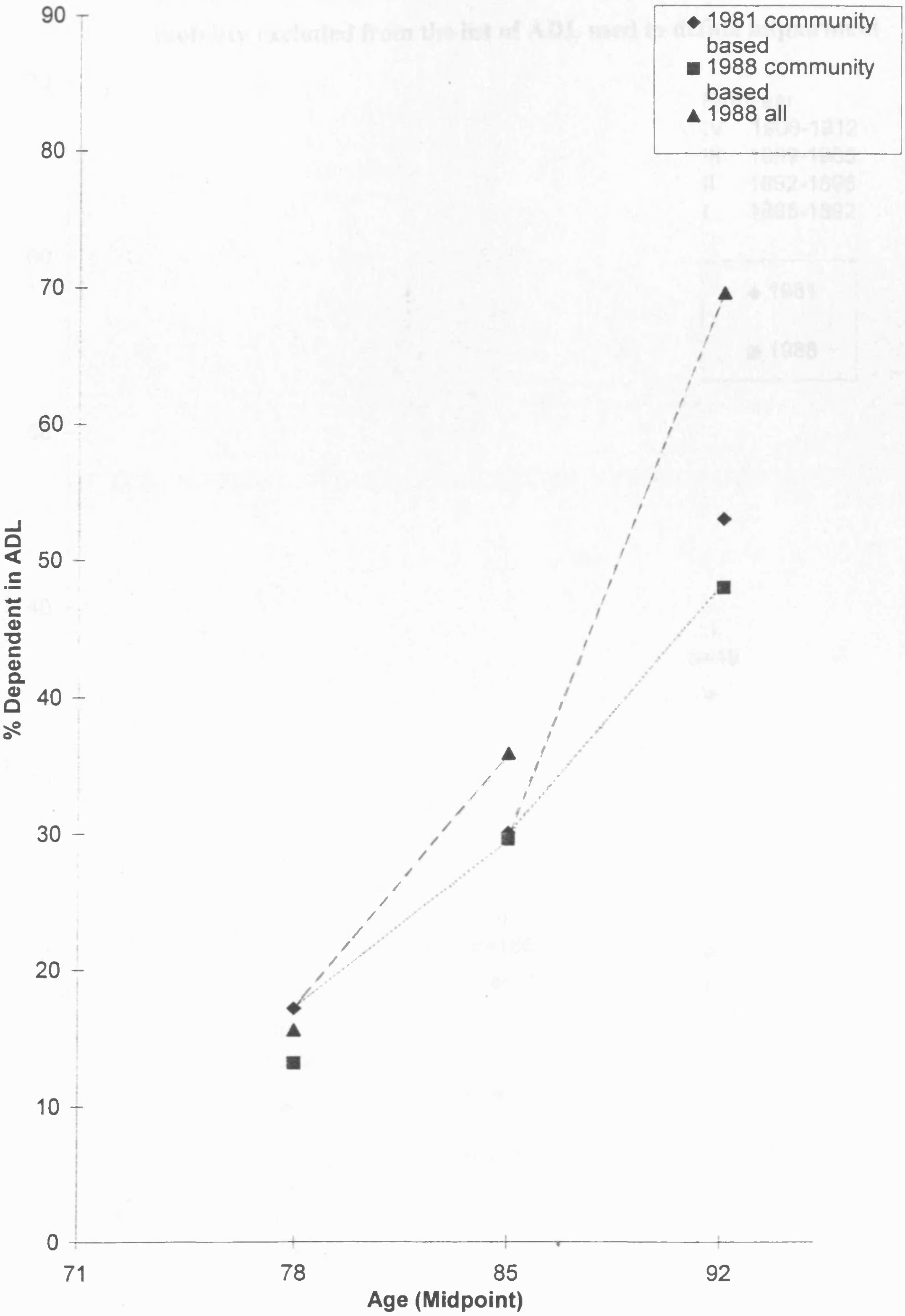
Dependency is defined as having help with at least one of mobility about the house, getting in and out of bed, getting in and out of a chair, dressing and eating

Figure 4.2: Percentage of men dependent in ADL and number surveyed, by age (midpoint of age group) and cohort; community-based population



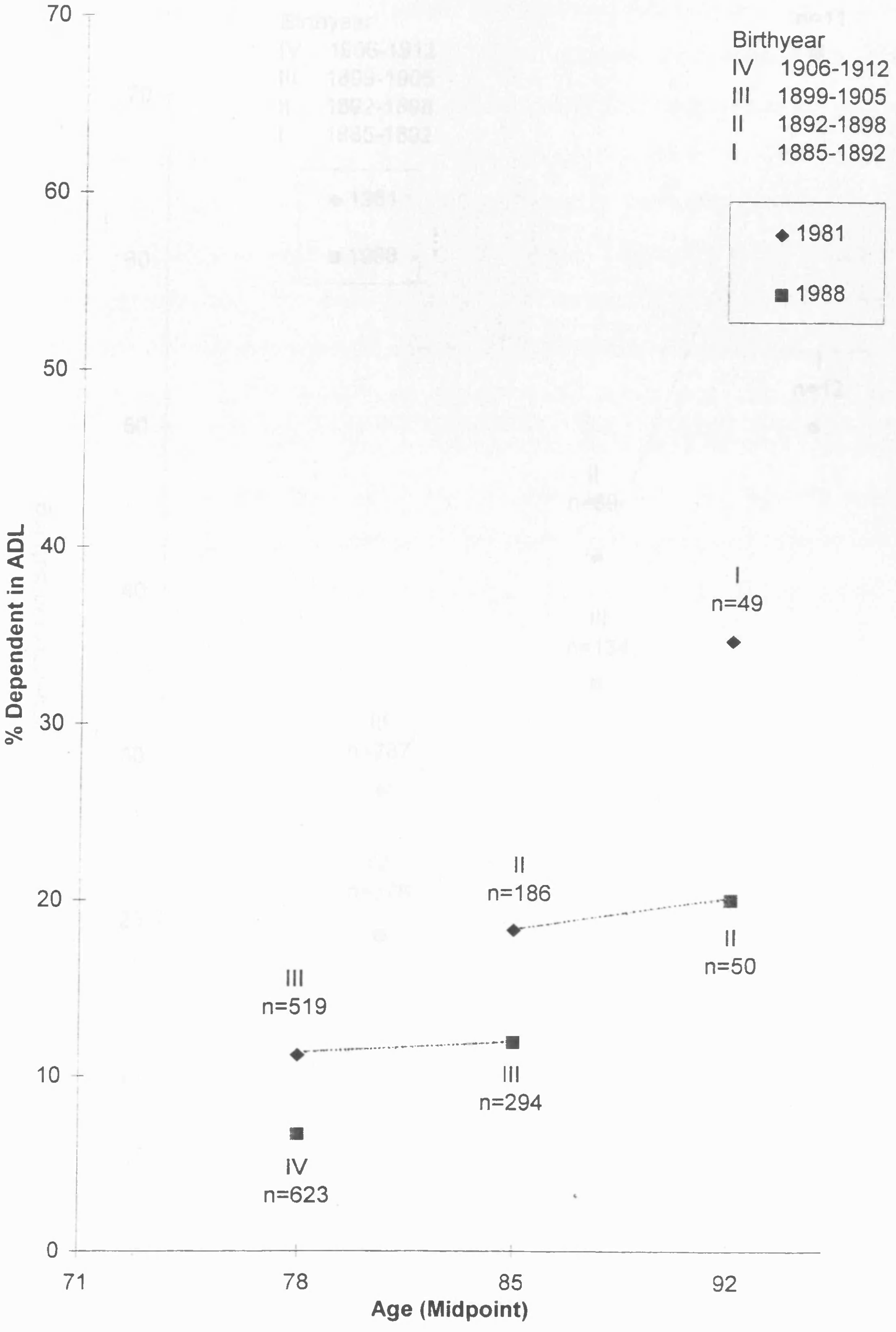
Dependency is defined as having help with at least one of mobility about the house, getting in and out of bed, getting in and out of a chair, dressing and eating

Figure 4.3: **Percentage of women dependent in ADL and number surveyed, by age (midpoint of age group) and cohort; 1981 community-based population**



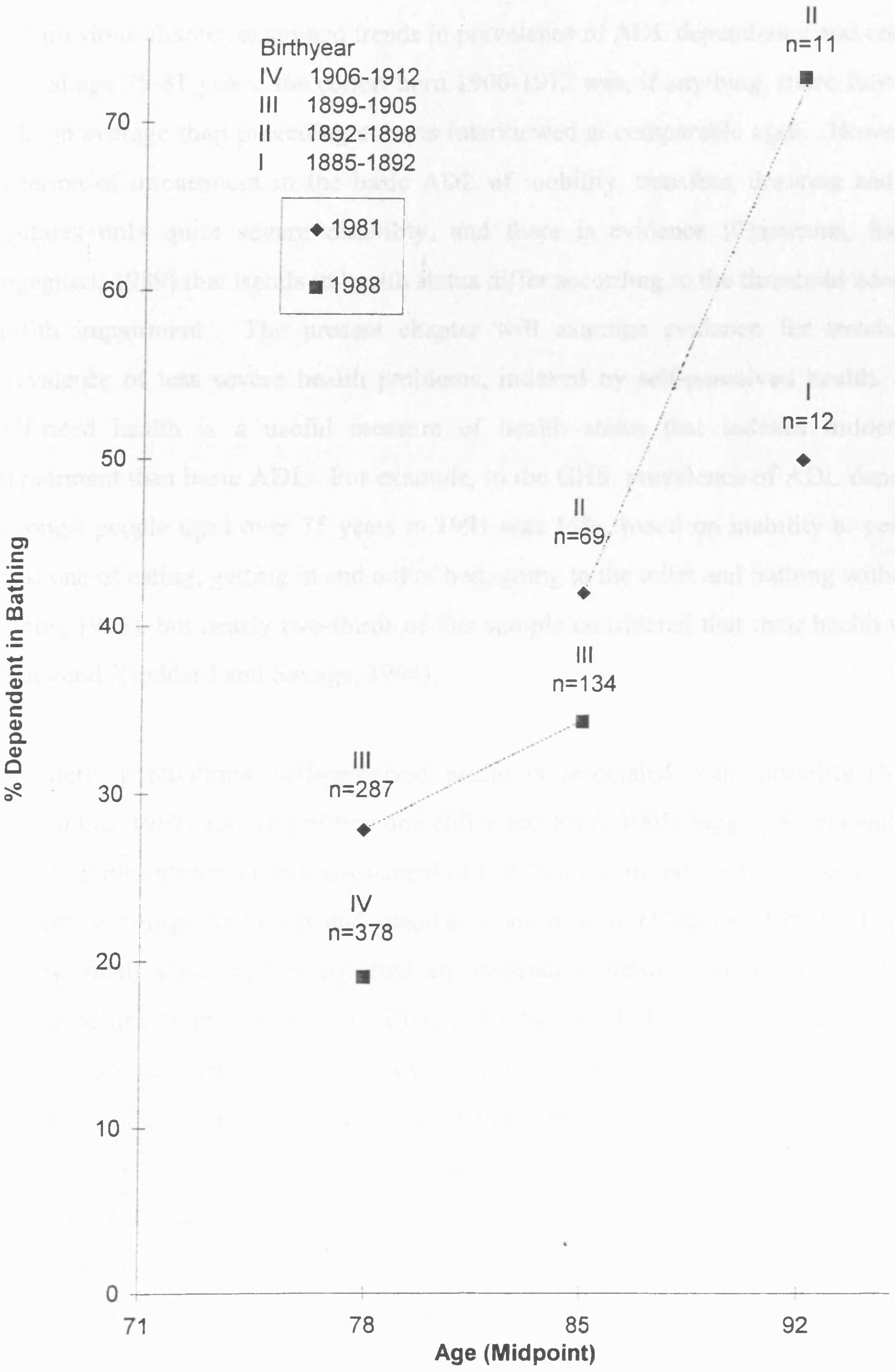
Dependency is defined as having help with at least one of mobility about the house, getting in and out of bed, getting in and out of a chair, dressing and eating

Figure 4.4: **Percentage of women dependent in ADL and number surveyed, by age (midpoint of age group) and cohort; community-based population; mobility excluded from the list of ADL used to define impairment**



Dependency is defined as having help with at least one of getting in an out of bed, getting in and out of a chair, dressing and eating

Figure 4.5: Percentage of men dependent in bathing and number surveyed, by age (midpoint of age group) and cohort; community-based population



5. TRENDS IN SELF-PERCEIVED HEALTH

The previous chapter examined trends in prevalence of ADL dependency and concluded that, at age 75-81 years, the cohort born 1906-1912 was, if anything, more functionally able on average than preceding cohorts interviewed at comparable ages. However, the criterion of impairment in the basic ADL of mobility, transfers, dressing and eating, captures only quite severe disability, and there is evidence (Crimmins, Saito and Ingegneri, 1989) that trends in health status differ according to the threshold adopted for health impairment. The present chapter will examine evidence for trends in the prevalence of less severe health problems, indexed by self-perceived health. Global self-rated health is a useful measure of health status that indexes milder health impairment than basic ADL. For example, in the GHS, prevalence of ADL dependency amongst people aged over 75 years in 1991 was 15%, based on inability to perform at least one of eating, getting in and out of bed, going to the toilet and bathing without help (Bone, 1995), but nearly two-thirds of this sample considered that their health was less than good (Goddard and Savage, 1994).

In elderly populations, self-perceived health is associated with mortality (Idler and Benyamini, 1997) and loss of function (Idler and Kasl, 1995; Jagger, Spiers and Clarke, 1993). Early interest in self-assessment of health was aroused by discrepancies between subjective ratings of health and medical examinations (Maddox, 1962). During the 1970s, small scale studies reported an association between good or excellent self-perceived health and survival (Pfeiffer, 1970; Singer et al, 1976; La Rue et al, 1979). Confirmation of these results in analyses of the Manitoba Longitudinal Study on Aging (Mossey and Shapiro, 1982) and the Alameda County Study (Kaplan and Camacho, 1983), sparked considerable interest in self-perceived health as an indicator of health. Subsequent community studies have shown the association with mortality to be robust. Idler and Benyamini (1997) review 27 studies of self-perceived health and survival, published between 1982 and 1996. The association with mortality remained significant in multivariate analyses in all but four studies, and there was often a graduated effect across categories of self-perceived health. Odds ratios mostly ranged from 1.5-3.0 for the extreme risk category. In two of the four studies where the association was not robust, covariates included a medical examination.

It seems probable that the association between self-perceived health and mortality is only explained when a full battery of other measures across all dimensions of health is taken into account. For example, Liang (1986) suggested that a model for health should include measures tapping the five health dimensions of self-reported problems, sick days, ADL, IADL and subjective health ratings. The association between self-perceived health and mortality is also supported in three recent studies not included in the 1997 review (Grant, Piotrowski and Chappell, 1995; Greiner, Snowdon and Greiner, 1996; van Doorn and Kasl, 1998). However, in a study of cardiovascular disease mortality, a strong age-adjusted association was largely explained by adjustment for risk factors and disease groups (Kaplan et al, 1996). A Japanese study of people aged over 65 years (Tsuji et al, 1994) suggests that the strength of association varies by cause, with self-perceived health being strongly associated with cancer mortality but showing no evidence of an association with heart disease mortality and only a non-significant association with mortality from stroke.

Associations between self-perceived health and covariates other than mortality have been examined in a number of studies. The expected associations between self-perceived health and symptom scores and reports of chronic conditions have been confirmed (for example, Stoller, 1984) and self-perceived health has also been shown to be associated with depression and psychological distress (Blazer and Houpt, 1979; Tessler and Mechanic, 1978; Mulsant, Ganguli and Seaberg, 1997). There are also positive associations between self-perceived health and level of education (Mulsant, Ganguli and Seaberg, 1997; Hays, Schoenfeld and Blazer, 1996, Wolinsky, 1990), and between self-perceived health and income (Hays, Schoenfeld and Blazer, 1996; Wolinsky, 1990).

Levels of self-perceived health differ by gender, with women tending to have worse self-perceived health overall, (Fillenbaum, 1979; Murray, Dunn and Tarnopolsky, 1982). However, women also have more reported health problems in general, and when this is taken into account in multivariate analyses, there is a slight but significant difference in levels of self-perceived health in favour of women (Hays, Schoenfeld and Blazer, 1996; Wolinsky, 1990). Idler and Benyamini report that, where analyses by gender were available, the association between self-perceived health and mortality was stronger for men than for women in five of seven studies reviewed, and this difference by gender is confirmed in a recent study (van Doorn and Kasl, 1998). However, in at least two studies the association with mortality was stronger in the female population (Grant, Piotrowoski and Chappell, 1995; McCallum et al, 1994). Johnson and Wolinsky (1994) found significant differences between male and female populations in associations between lower and upper body limitations and ADL and self-perceived health. For example, limitations in basic ADL were more strongly associated with lower levels of self-perceived health in men.

Associations between self-perceived health and age vary according to the age groups considered, depending upon the angle of focus. As might be expected, older people in general are more likely to report that their health is less than good, but multivariate analyses suggest that people aged over 75 years maintain better self-perceived health in the face of more health problems than younger adults (Mulsant, Ganguli and Seaberg, 1997; Hays, Schoenfeld and Blazer, 1996; Schulz et al, 1994). However, this is contradicted in a UK study (Murray, Tarnopolsky and Chappell, 1982), which reported higher levels of self-perceived health in people aged over 75 years, approaching statistical significance, despite adjustment for reported symptoms and presence of longstanding illness. Generally, reported associations with age within the 75+ age group are inconsistent, due both to cohort differences and to small numbers surveyed. Repeated surveys including successive cohorts are needed in order to untangle age, period and cohort differences. The only comprehensive accounts of self-perceived health as cohorts age beyond 75 years are from US populations surveyed in the Health Interview Survey (Wolinsky, 1990) and the EPESE studies (Idler, 1993) described in

Chapter 1. Results from these are not entirely consistent, and will be reviewed in Chapter 8, in order to draw comparisons with results from the present study.

This chapter investigates trends in self-perceived health, in the context of trends in dependency discussed in Chapter 4. Because self-perceived health is inherently subjective, there may be systematic changes over time in the relationship between responses to the self-perceived health item and underlying dimensions of health at population level. Therefore, predictive validity of self-perceived health for survival is assessed by analysis of five-year survival at each survey. Because less than good self-perceived health captures ill-health at a somewhat milder level than ADLs, changes in the distribution of self-perceived health over time may be of particular relevance for prediction of demand for primary care services.

5.1 Methodology

The methodology employed is essentially the same as for the cohort analysis of ADL dependency in the previous chapter. The dependent variable in the logistic regression is self-perceived health, in the form of dichotomised responses to the question "For your age, would you say in general that your health is good, fair or poor?". This question was not asked of respondents interviewed in institutions, these people being excluded from the analysis, as before. Because relatively few people rated their health as 'poor', responses are dichotomised into 'good' and 'less than good', with relatively little information lost as a result. The very small number of participants interviewed at home for whom self-perceived health was missing were included in the less than good category. As before, the modelling process had two stages, with models fitted firstly within the age-cohort framework, and secondly within an age-period framework.

Models fitted for prevalence of less than good self-perceived health are summarised in Table 5.1. In addition to straightforward age-cohort and age-period models, describing trends in self-perceived health in the community-based population as a whole, more complex models included ADL dependency as a dichotomous covariate. As before, ADL dependency was defined as using human or mechanical help in at least one of mobility about the house, transfer to and from bed, transfer to and from a chair, dressing and eating. The models allow the odds of less than good self-perceived health to vary between subpopulations defined by dependency. Additive models, allowing the pattern of age and cohort or period differences to be reproduced with a fixed increment in the logodds by dependency (Figure 5.1) are compared to interaction models, where the odds ratios for comparisons by age, cohort and period themselves vary according to ADL status. The interpretation of the additive models is that trends in self-perceived health, measured by percentage increase in the odds of less than good self-perceived health, are identical, when subpopulations independent and dependent in self-perceived health are compared. This pattern is consistent with independence between trends in ADL dependency and trends in self-perceived health. Departure from the additive model implies an interrelationship between trends in self-perceived health and dependency, although interpretation is not straightforward because of the intervening effects of mortality and transitions to and from dependency between the two surveys.

5.2 Prevalence of less than good self-perceived health

The proportions with less than good self-perceived health in the community-based population by cohort are given in Table 5.2. Prevalence of less than good self-perceived health are rather higher than prevalence of dependency in ADL. Overall, 40.1% of the population in 1981 and 47.8% in 1988 considered themselves to be in less than good self-perceived health, compared to 20.8% and 19.5% respectively who were dependent in ADL. Within each cohort, women were more likely than men to perceive their health as less than good. In terms of ADL prevalence, the gender gap in favour of men narrowed between 1981 and 1988, but in contrast the gender gap with respect to self-perceived health persisted (Figure 5.2). Whilst prevalence of ADL dependency was stable or decreasing, prevalence of less than good self-perceived health was higher in 1988 for both male and female populations.

The pattern of intercohort differences in prevalence of self-perceived health is not at all what might be predicted from the findings for ADL dependency. Indeed, in the female population, trends in dependency and self-perceived health are opposing. Diagonal comparisons in Table 5.2 indicate greater proportions of elderly women rating their health as less than good in more recent cohorts, contrasting with stability or improvement in levels of ADL dependency. For example, 43% of women aged between 75 years and 81 years considered their health to be less than good in 1981, increasing to 51% of women of comparable age in 1988. The corresponding prevalence of ADL dependency were 13% in 1981 decreasing to 9% in 1988. On the basis of the ADL measure, the female cohort aged 75 years to 81 years in 1988 was more functionally able, but aggregating subjective perceptions of health gives a picture of a cohort in poorer health than its precursors.

When differences in prevalence of less than good self-perceived health between each pair of succeeding cohorts are examined, in both male and female populations, in each case the more recent cohort has greater prevalence of less than good self-perceived health. These differences are represented by the vertical distances between age-specific prevalences in Figures 5.3 and 5.4. The intercohort differences, expressed as the ratio of odds of less than good self-perceived health, compared to odds in the 1906-1912 cohort, are large enough in the female population to be statistically significant, with confidence intervals not including unity (Table 5.3). For the male population, the intercohort differences are consistent in direction with those observed for the women, but not statistically significant, largely because the odds ratios are somewhat closer to unity, but also because numbers are smaller

Within cohorts, the prevalence of less than good self-perceived health increased slightly as the cohorts aged, at least between ages 75 years and 88 years. A linear increase in the logodds with age is assumed, but this may be an inaccurate assumption at the greatest ages, where there are rather low levels of less than good self-perceived health, albeit with small numbers interviewed. However, the small numbers surviving make inferences concerning the relationship between self-perceived health and age at this great age speculative. Because of the possibility of model misspecification, the analysis for men was repeated with the 89-95 year-old age group excluded, but the findings for the younger age groups were not substantially altered.

Turning to an age-period model, also presented in Table 5.3, similar conclusions are drawn of a statistically significant trend in prevalence of less than good self-perceived health amongst women, with a parallel, but non-significant finding for men. However, assessed cross-sectionally, there is no evidence of a trend in the prevalence of less than good self-perceived health with age.

5.3 Interrelationship between less than good self-perceived health and ADL dependency

In order to investigate interrelationships between ADL dependency and self-perceived health, prevalence of less than good self-perceived health were modelled, allowing for variation by ADL dependency, as well as by age and cohort or period. Prevalence of less than good self-perceived health, by age, birth cohort, survey and ADL dependency for women are presented in Figure 5.5. As expected, less than good self-perceived health was much more common amongst the subgroup who were dependent in ADL (Table 5.4). Odds of less than good self-perceived health are nearly trebled for women dependent in ADL, compared to their independent peers (Table 5.5). A model with additive effects for age, cohort and ADL dependency is a good fit for the data. The association between less than good self-perceived health and ADL dependency is consistent across cohorts, and the relatively high prevalence of less than good self-perceived health in the cohort born 1906-1912 is apparent in both dependent and independent subpopulations. Similarly, in the age-period framework, an additive model with age, survey and dependency included as covariated fitted well, and odds ratios were quite similar to those when dependency was not taken into account. Thus, for women, conclusions of a trend in self-perceived health were not materially altered by adjustment for dependency in ADL.

Self-perceived health and ADL dependency were associated even more strongly in the male population (Figure 5.6). Odds of less than good self-perceived health were quadrupled for men dependent in ADL, compared to their independent peers (Table 5.5). Levels of less than good self-perceived health remained stable as the cohorts aged. In the independent subpopulation cohort differences were small and statistically non-significant, although exhibiting a trend towards worse self-perceived health in the newer cohorts. In the dependent subpopulation, numbers are relatively sparse, and conclusions for the small groups interviewed at ages 82-88 in 1981 are hard to draw. However, the comparison between members of the 1899-1905 and 1906-1912 cohorts interviewed at ages 75-81 is based upon reasonable numbers. Prevalence of less than good self-perceived health amongst men in the 1906-1912 cohort who were dependent in ADL was particularly high, compared to those born in 1899-1905, such that the intercohort difference observed in the earlier unadjusted analysis was largely due to differences amongst the dependent men.

The possibility of systematic difference in magnitude of the intercohort differences between dependent and independent subpopulations was investigated by fitting models with an interaction term, allowing intercohort differences themselves to differ between independent and dependent subpopulations (Table 5.5). There was some evidence of greater intercohort differences in the dependent subpopulation, but the goodness of fit statistic for the model (0.013 on 1 degree of freedom) suggests that the predicted values may have been fitting too closely to quirks of the observed data to support generalisation.

5.4 Self-perceived health and survival

To establish the enduring relationship between self-perceived health and mortality, five-year survival and the association between five-year survival and self-perceived health were compared for the two surveys, using Cox's proportional hazards model (Cox, 1972). Five-year survival for the two periods was compared separately by gender for community-based populations in each survey, with age group and self-perceived health included as covariates.

The association between self-perceived health and mortality was modelled separately for men and women, with age, ADL dependency, incontinence, presence of cognitive impairment, social class, and a three-level variable indicating marital status and household composition (married/not married, not living alone/not married and living alone) included as covariates. Missing values were included in the final category. A stepwise approach was used, with separate analyses for the two surveys. An interaction term, was also included, in order to test for attenuation in the strength of any association between self-perceived health and survival with age. For a consistent comparison, the final model included all covariates that were significant in either of the two surveys. The proportional hazards assumption was tested by fitting each of the covariates in turn as time dependent.

In the initial models by survey, age, sex, self-perceived health, ADL dependency and cognitive impairment were all significantly associated with survival. Absence of incontinence was also associated with survival in some cases, but there was no consistency in this association across gender and survey. There was no significant relationship between survival and social class, and this variable was omitted from subsequent analyses. Risk ratios by self-perceived health and other covariates are given in Tables 5.6 and 5.7, for men and women respectively. Men who lived alone were significantly less likely to die (RR 0.59, 95% CI 0.37 to 0.94), after adjustment for all other factors in 1981, but this association was not replicated in 1988 (RR 1.32, 95% CI 0.97 to 1.78). Otherwise no association was found between survival and living arrangements.

In the male population, the association between self-perceived health and survival is statistically significant for both surveys, although the adjusted hazard ratio is somewhat reduced in 1988 (risk ratio 1.49; 95% CI 1.12 to 1.97), compared to 1981 (risk ratio 2.07; 95% CI 1.47 to 2.92). However, when the analysis was restricted to participants aged 75-81 years, the hazard ratios at the two surveys were very similar (Table 5.8). When the proportional hazards assumption was tested, there was no statistically significant evidence of time-variance, although evidence that the association with self-perceived health attenuates over time approached statistical significance (1981, p=0.077; 1988, p=0.054).

The association between self-perceived health and survival is not as strong for women as in the male population. In 1981, the association was much weakened when ADL dependency was included in the model (Table 5.7). However, in this case it was difficult to untangle associations with dependency and age. There was statistically significant evidence that the strength of the association between self-perceived health and survival weakens with age. When analysis was restricted to women aged 75-81 years, self-perceived health was a statistically significant predictor of mortality, with similar hazard ratio in 1981 and 1988 (Table 5.8). Absence of an association for the population aged over 75 years as a whole in 1981, was attributable to a reversal in the women aged 82 years and over; in this subgroup, good self-perceived health was associated with slightly *worse* survival in the five years from 1981, in the multivariate analysis. For women interviewed in 1988, there was a reasonably strong association between self-perceived health and survival, and in contrast to the results for 1981, attenuation of the predictive value of self-perceived health only took place at the oldest ages where numbers were very small. There was no evidence of a departure from the proportional hazards assumption for any of the covariates in the final model in the female population.

Although it was hard to discern a clear pattern of associations in the population aged 82-88 years, there was some evidence that the predictive value of self-perceived health for mortality may not apply at these ages for women. However, the data support the enduring validity of self-perceived health with respect to survival, for cohorts aged 75-81 years in 1981 and 1988, with this association being rather stronger for men than for women.

5.5 Ageing and longitudinal change in self-perceived health

In order to further investigate the relationship between ageing and self-perceived health, elderly people who were interviewed in the community in 1981, and survived to be interviewed in the community again in 1988, were entered into a longitudinal analysis, to investigate the relationship between ageing and self-perceived health. Weighted least squares regression on with logodds of less than good self-perceived health as the dependent variable was used to adjust standard errors to allow for correlation between the self-perceived health measure in 1981 and 1988 (Agresti, 1990).

Transitions in self-perceived health, together with self-perceived health distributions for those surviving participants who were interviewed at home both in 1981 and in 1988, are given in Table 5.9. A total of 276 women and 117 men had repeated attributions of self-perceived health at the two surveys. Comparing the responses in 1981 and 1988, there was a marked decline in levels of self-perceived health. With correlation due to repeated measures on the same individuals adjusted for, the estimated odds ratio for less than good self-perceived health in 1988 compared to 1981 was 1.69 with 95% confidence interval (1.31, 2.18). The odds ratio was virtually unchanged by adjustment to allow for higher levels of less than good self-perceived health in the female population. There was no evidence that the odds ratio for less than good self-perceived health by age differed between male and female populations. When the analysis was repeated with the small number of participants aged 82+ years at the time of first interview in 1981 excluded, the odds ratio for the less than good self-perceived health by survey reduced only slightly, to 1.56 (95% confidence interval 1.19 to 2.03), so there was little evidence that the rate of decline in levels of self-perceived health accelerates with age.

5.6 Robustness of the conclusions

Some of the trend towards less than good self-perceived health may be explained by lower rates of institutionalisation in 1988, together with associations between institutionalisation and ADL dependency, and ADL dependency and less than good self-perceived health. All other rates being equal, fixed availability of places in institutions, together with an ageing population, implies a group of elderly people resident in the community in 1988 whose disabilities would have lead to them being institutionalised in 1981. These people might generally be expected to have less than good self-perceived health. The extent to which changing rates of institutionalisation could explain the trend in self-perceived health was explored by projecting age-sex rates of institutionalisation from 1981 onto the population in 1988. The result was an institutionalised population in 1988 of 99, with the excess of projected over actual numbers in institutions being 4.1 for men and 15.9 for women. These numbers are quite small, and when the analysis was repeated, with this number of people removed in 1988, making the extreme assumption that they would all have less than good self-perceived health, results were essentially unchanged. Moreover, it is likely that the effect of changing rates of institutionalisation will be smaller than this. However, as discussed in Chapter 3, it is probable that age and sex-specific rates of institutionalisation in 1988 were somewhat higher than this, explained by migration to homes outside the practice boundary. In this case there would be selective attrition of the subpopulation in poor or fair self-perceived health, suggesting that the trend towards less than good self-perceived health may be understated.

More generally, for emigration to be responsible for the trend in self-perceived health, rates would have to be differential, with greater outmigration amongst elderly people with good self-perceived health. Little is known about emigration from this population. When the effect of immigration was investigated using similar methods to those described in Chapter 4 for the analysis of ADL dependency, conclusions with regard to trends and trajectories in self-perceived health were substantially unchanged.

The measure of self-perceived health used here is relative; the question includes the qualifier "For your age,...". This should be taken into account in interpreting the results. Rakowski et al (1993) included both global and comparative self-perceived health in analysis of mortality using the Longitudinal Study on Ageing. In a model with global self-perceived health, comparative self-perceived health explained additional variation in survival, suggesting that both forms have predictive validity for survival, but that they are not interchangeable. This is supported by Krause and Jay (1994) who asked respondents to explain their global health assessments and found that these were attributed to direct comparison with the health of others by only a small minority of respondents. The age qualifier depresses prevalence of less than good self-perceived health, and should suppress the correlation between self-perceived health and age. However, trends in global and comparative self-perceived health across cohorts might be expected to broadly correspond.

Prevalence of less than good health reported here compare well with results from the Hughes Hall Project for Later Life (Dening et al, 1998). However, at follow-up in 1991/2 six years after the original study, the survivors in Cambridge had noticeably better self-perceived health than at baseline, which is at odds with the results in Melton. It is not clear to what extent this difference is due to bias introduced by losses to follow-up, or alternatively reflects the different nature of the study population in Cambridge, which was predominantly urban and possibly more highly educated. The Health and Lifestyle Survey (Cox, Huppert and Whichelow, 1993), which followed up a three-stage random sample of the population of England, Scotland and Wales also showed a decrease in prevalence of less than good self-perceived health amongst survivors aged 74 years and over at baseline reinterviewed after seven years, but with considerable losses to follow-up. Male prevalence of less than good self-perceived health in the initial wave of the Health and Lifestyle Survey in 1984/5 was also somewhat lower than in Melton.

Differences in prevalence between surveys may also be due to random fluctuations in the time series for self-perceived health, which are impossible to detect with only two timepoints. Time series for self-reported health, such as the GHS prevalence of limiting longstanding illness, tend to show considerable volatility. For example, 1980's time series in the Netherlands for Healthy Life Percentage, based upon self-perceived health and Health Disability Ratio, based upon 10 items from the OECD disability indicator both show considerable year on year fluctuations (Perenboom, Boshuizen and van de Water, 1993).

5.7 Trend in self-perceived health: cohort or period effect?

Although there was little or no increase in the prevalence of functional dependency arising from severe disability in the elderly population, participants from the most recent cohort had, on average, worse subjective ratings of health. This cohort difference is statistically significant for women, and also present in more muted form for men. There were particularly high levels of less than good self-perceived health amongst men aged 75-81 years in 1988 who were dependent in ADL, although relatively small numbers of dependent men make generalisation of this finding questionable. Whilst trends in self-perceived health were interrelated with ADL dependency for men, with the decline in levels of less than good self-perceived health being largely confined to men who were dependent, trends in self-perceived health and dependency were opposite and seemingly unrelated for women.

Once effects of migration and institutionalisation have been accounted for, the trend in levels of self-perceived health in the population may be attributed to any or all of the following:

i.) Increased incidence of fair/poor self-perceived health.
ii.) Decreased incidence of good self-perceived health.
iii.) Increased survival amongst persons with less than good self-perceived health.
iv.) Decreased survival amongst persons with good self-perceived health.
v.) Random fluctuation in the time series.

Of these, only decreased survival amongst individuals with good self-perceived health is implausible, both intuitively, and in the face of generally increasing rates of survival. The other four may all play some part. Increased proportions of persons with less than good self-perceived health in the newer cohorts may be related to differing rates of survival. Firstly, the newer cohorts of elderly are more numerous, largely due to a rapid decline in infant mortality in the early years of the 20th century (Grundy, 1997), but also to World War I, and to the contribution of new health technology in reducing mortality in middle age (Charlton, Fraser and Murphy, 1997). A result may be weakening of the selection effect of mortality, including emergence of a growing subpopulation who have survived a life-threatening disease, with implications for their subsequent health. Moreover, increased survival has been accompanied by increased incidence of certain common conditions in middle and old age, primarily cancers and cardiovascular disease. The possibility that these effects may have combined to produce higher levels of less than good self-perceived health in the newer cohorts is examined in more detail in Chapter 8.

Changes in incidence of transitions to and from less than good self-perceived health may be attributable either to period or cohort effects. Influences upon survival and incidence of chronic conditions are played out over years and lifetimes, and may be analysed in terms of age-cohort models, with appropriate adjustment for changes in ascertainment and treatment. Self-perceived health may also be susceptible to more short term changes in the environment and functioning of the individual. In the case of ADL dependency, it was possible to draw a conceptually clear distinction between period effects, attributable to measurement and/or environment, and cohort effects attributable to change in incidence of conditions and impairments. Such a distinction is harder to draw in relation to self-perceived health, because of the subjective nature of the measurement. The threshold between fair and good self-perceived health will vary from individual to individual, and this may include systematic variation relating either to the immediate environment (period), as well as to accumulated lifetime experience (cohort).

Lower levels of self-perceived health in the newer cohorts may be attributed to period effects upon perceptions of health. For example, increased visibility of elderly people and emphasis on active ageing may have inflated expectations of health during the 1980s, and correspondingly depressed health ratings. Barsky (1988) and Becker (1993) have discussed a "paradox of medical progress", whereby increased focus on health issues may actually depress self-perceived health, by fostering amplified awareness of bodily symptoms, and a climate of alarm about disease. Alternatively, it has been suggested (Idler 1993) that self-perceived health may reflect resources available to support health. So a decline in levels of self-perceived health may reflect restrictions in availability of formal support and health services. There is some evidence of fixed supply of services meeting increased demand in this population. The absolute number of district nurse visits in the past month, and of appliances for assistance with toileting was the same in 1988 as in 1981, as well as the number of institutional places.

On the other hand, self-perceived health may be affected more by longstanding influences than by the immediate environment. As they age, people may bring with them longheld values with respect to health, attributable to cohort experiences, such as stoicism in the World War I generation, which may lead them to minimise their health problems. Felton (1987) presents data which support the hypothesis that associations between health and happiness are stronger in pre-1900 cohorts, and that, for these cohorts, happiness was more likely to be limited to descriptions of themselves as religious, moral or virtuous. Minimisation of health problems, and maintenance of good self-perceived health in the face of the effects of ageing, may be consistent with this set of cultural values. At least in the USA, it has been argued that the years around 1900 marked a watershed in living conditions, drawing a distinction between cohorts born before and after this date (Idler 1993).

Differentiating between these explanations, or between cohort and period effects, is impossible because data are restricted to two cross-sectional surveys. However, comparison with other time series may throw more light on the plausibility of alternative explanations for the trend. Cohort analysis of the General Household Survey by Jarvis (1998) provides the most comprehensive source of UK data. Age-specific prevalence of good self-perceived health were lower in the GHS than in Melton, and when three-year moving averages within five-year cohorts are plotted, there is little or no evidence of cohort differences, although adjustment for sampling variation is not made. For both men and women the cohort born in 1905-1909 had lower prevalence of good self-perceived health in their early eighties, than the cohorts born in 1900-1904 or 1910-1914, but this difference was not sustained. The most complete time series for self-perceived health is available from four cross-sectional waves of the Health Interview Survey (HIS), analysed by Wolinsky (1990). The time series covers four-year birth cohorts born from 1872 through 1929, interviewed at ages 56 years upwards. Figure 5.7 is created from prevalence of less than good self-perceived health reported in Wolinsky's monograph. Wolinsky concludes that levels of self-perceived health decline as cohorts age, up to age 80 years, when levels stabilise and even improve, when other measures of health status are taken into account. Results here are consistent with this, although, evidence at ages over 80 years is limited. The most interesting feature of the HIS time series is a strong suggestion of a period effect, applying only to cohorts at ages 70 years and over. Five cohorts, aged between 80-99 years, experienced a marked increase in prevalence of less than good self-perceived health at the 1984-85 wave, with the next youngest cohort, aged 76-79 years, also showing a more muted effect. The magnitude of this difference is well outside the bounds of expected heterogeneity due to diminishing sample sizes at older ages, and the staged nature of the differences, occurring across cohorts at different ages but all during the early 1980s, strongly suggests a period effect. Wolinsky attributes this effect to reform of health care supply and insurance in the US during the early 1980s, and accompanying media discussion and blaming of the elderly population for increased health care costs. Although alternative explanations, such as increased expectations of health at advanced age, are possible, the time series does suggest that self-perceived health is susceptible to influence of the immediate environment.

The HIS times series provides only limited evidence of cohort differences, with relatively high prevalence of less than good self-perceived health in the cohorts born 1889-1896. A cohort effect, with worse self-perceived health amongst the cohort born in 1900-1905, is more strongly supported data from New Haven Connecticut, analysed by Idler (1993). However, the findings are not directly comparable, as Idler reports prevalence of less than good self-perceived health adjusted for demographic status and self-reported health conditions, in the form of residuals in an ordinary linear regression model and moreover the design is longitudinal. Evidence from the US therefore tends on the whole to support period-based rather than cohort-based explanations for the trend in self-perceived health, but both possibilities remain open.

Inconsistencies in the association between self-perceived health and survival at ages 82 years and over suggest that interpretation of self-perceived health responses in this age group is unclear. However, amongst people aged 75-81 years, self-perceived health was as strong a predictor of five-year mortality in 1981 as in 1988, although there were some differences between the male and female populations with respect to the set of predictors of survival. The fact that self-perceived health continued to be a strong predictor of five-year survival in 1988 suggests that increased levels of less than good self-perceived health in newer cohorts, if sustained, may have implications for population health and hence for planning of health services.

Self-perceived health is associated not only with survival and loss of function, but also with health service use. Therefore, Chapter 6 explores interrelationships between self-perceived health, GP contact and other sociodemographic and health-related predictors, whilst Chapter 7 relates the declining levels of self-perceived health across cohorts to trends in GP contact. Finally, in chapter 8, trends in ADL dependency, self-perceived health and GP contact are evaluated together, in order to seek explanations for the apparent decline in levels of self-perceived health, the policy significance of this trend, and implications for future health service planning and development.

5.8 Summary

Two-factor age-cohort and age-period models were fitted for prevalence of self-perceived health for the seven-year birth cohorts at both surveys. The cohorts surveyed were born in 1906-1912, 1899-1905 and 1892-1898, with small numbers included from the cohort born in 1885-1891. Women were generally more likely than men to have less than good self-perceived health and this gender gap remained stable across the cohorts surveyed.

Results from age-cohort models, and from a longitudinal model for self-perceived health in survivors interviewed at both surveys confirm that, as cohorts age, the prevalence of less than good self-perceived health increases. However, this increase is largely accounted for by the increase in prevalence of ADL dependency with age. The ageing effect is masked in cross-sectional analyses by a cohort difference. Although the newer cohorts had better levels of health, measured by lack of ADL dependency, perceptions of health were less favourable on average than in earlier cohorts surveyed at comparable age. The cohort difference is statistically significant for women, but in men the cohort difference is confined largely to the subpopulation dependent in ADL and statistically significant only for comparisons between dependent subgroups. Self-perceived health is confirmed as a predictor of five-year survival, at ages 75-81 years, but not at older ages. Possible explanations for the trend in self-perceived health include unexplained short-term fluctuations in the time series, effects due to survival, changing patterns of morbidity, and influences of the immediate environment, and of lifetime health experience.

Table 5.1: Two-factor models fitted for male and female populations

Model Number	Response	Explanatory Variables
1.	% with less than good self-perceived health	age, cohort
2.	% with less than good self-perceived health	age, period
3.	% with less than good self-perceived health	age, cohort, ADL dependency
4.	% with less than good self-perceived health	age, period, ADL dependency

Table 5.2: Proportion (%) in less than good self-perceived health by sex, age (midpoint of age group), cohort (defined by birth year) and year of survey

	Women				**Men**			
Cohort (age at 31/12/1980)	**1981**		**1988**		**1981**		**1988**	
	%	**(n)**	**%**	**(n)**	**%**	**(n)**	**%**	**(n)**
IV (68-74 yrs)	-	-	51	(620)	-	-	44	(375)
III (75-81 yrs)	43	(518)	50	(290)	38	(287)	43	(131)
II (82-88 yrs)	41	(185)	46	(50)	38	(69)	36	(11)
I (89-95 yrs)	31	(48)	60	(10)	17	(12)	-	-
Total	41	(753)	50	(970)	37	(368)	43	(518)

Table 5.3: **Estimated odds ratios of less than good self-perceived health under age-period and cohort models for men and women separately, 95% confidence intervals (CI) in parentheses; persons interviewed at home**

Model	**Covariates**	**Women** **OR[a] (95% CI)**	**Men** **OR[a] (95% CI)**
(1) Cohort	Cohort IV	1.00	1.00
	Cohort III	0.73(0.57,0.92)	0.79(0.58,1.09)
	Cohort II	0.51(0.32,0.79)	0.63(0.32,1.25)
	Cohort I	0.25(0.11,0.58)	0.18(0.03,1.03)
	Age (longitudinal)	1.04(1.00,1.08)	1.02(0.96,1.09)
	X^2	0.08	0.13
	degrees of freedom	1	1
(2) Age + Period	1981	1.00	1.00
	1988	1.42(1.17,1.73)	1.30(0.98,1.71)
	Age (cross-sectional)	0.99(0.96,1.01)	0.98(0.94,1.03)
	X^2	1.2	1.7
	degrees of freedom	3	3

[a]Odds ratio of less than good self-perceived health:good self-perceived health

Table 5.4: **Proportion (%) with less than good self-perceived health by sex, age (midpoint of age group), cohort (defined by birth year), ADL dependency and year of survey**

Cohort (age at 31/12/1980)	ADL Dependency	Women				Men			
		1981		1988		1981		1988	
		%	(n)	%	(n)	%	(n)	%	(n)
IV (68-74 yrs)	Independent	-	-	48	(541)	-	-	39	(330)
	Dependent	-	-	72	(82)	-	-	80	(48)
III (75-81 yrs)	Independent	38	(430)	45	(207)	34	(246)	33	(91)
	Dependent	66	(89)	63	(87)	61	(41)	62	(43)
II (82-88 yrs)	Independent	31	(130)	38	(26)	27	(52)	29	(7)
	Dependent	65	(56)	54	(24)	71	(17)	50	(4)
I (89-95 yrs)	Independent	22	(23)	40	(5)	14	(7)	-	-
	Dependent	40	(26)	80	(5)	20	(5)	-	-

Table 5.5: Estimated odds ratios of less than good self-perceived health adjusting for independence in ADLs under age-period and cohort models for men and women separately, 95% confidence intervals (CI) in parentheses; community-based population

Model	Covariates	Women OR[a] (95% CI)	Men OR[a] (95% CI)
ADL + Cohort + Age	Cohort IV	1.00	1.00
	Cohort III	0.69 (0.54, 0.88)*	0.76 (0.54, 1.05)
	Cohort II	0.47 (0.29, 0.74)*	0.66 (0.32, 1.35)
	Cohort I	0.21 (0.08, 0.48)*	0.17 (0.02, 1.00)
	Independent	1.00	1.00
	Dependent	2.81 (2.17, 3.62)*	4.05 (2.75, 5.95)*
	Age (longitudinal)	1.02 (0.98, 1.07)	0.99 (0.93, 1.06)
	X^2	3.7	3.6
	degrees of freedom	6	6
ADL + Cohort + Age, with ADL-cohort interaction	*Independent*		
	Cohort IV		1.00
	Cohort III		0.81 (0.58, 1.15)
	Cohort II		0.58 (0.26, 1.29)
	Dependent		
	Cohort IV		1.00
	Cohort III		0.40 (0.16, 0.97)*
	Cohort II		0.60 (0.15, 2.33)
	Age (longitudinal)		0.99 (0.93, 1.07)
	X^2		0.6
	degrees of freedom		3
ADL + Age + Period	1981	1.00	1.00
	1988	1.50 (1.22, 1.83)*	1.32 (0.99, 1.76)
	Independent	1.00	1.00
	Dependent	2.79 (2.16, 3.60)	4.01 (2.73, 5.88)
	Age (cross-sectional)	0.96 (0.93, 0.99)*	0.95 (0.90, 0.99)
	X^2	5.2	5.5
	degrees of freedom	8	8

[a]Odds ratio of 'less than good': 'good' self-perceived health, where 'less than good' includes those resident in institutions

Table 5.6: Five-year survival: relative risks of death by sociodemographic and health status; men resident in the community in 1981 and 1988

	1981		1988	
	Relative Risk		Relative Risk	
Covariates Included	**Age, sex**	**All**[1]	**Age, sex**	**All**[1]
Age	1.11***	1.14***	1.10***	1.07***
Self-Perceived Health				
Good	1.00	1.00	1.00	1.00
Fair/Poor/missing	2.19***	2.07***	1.85***	1.49**
Living Arrangements				
Married	-	1.00	-	1.00
Not married, with others	-	1.17	-	1.16
Not married, alone	-	0.59*	-	1.32
ADL Dependency				
Independent	-	1.00	-	1.00
Dependent	-	1.83**	-	1.85***
Incontinence				
Not incontinent	-	1.00	-	1.00
Incontinent of urine or Faeces	-	1.05	-	1.52*
Cognitive Impairment				
IO score 9-12	-	1.00	-	1.00
IO score 0-8	-	2.92	-	2.31***

[1]Final model includes all covariates found to be statistically significant for either sex at either survey.

*$p<0.05$, **$p<0.01$, ***$p<0.001$

Table 5.7: Five-year survival: relative risks of death by sociodemographic and health status; women resident in the community in 1981 and 1988

	1981		1988	
	Relative Risk		Relative Risk	
Covariates Included	**Age, sex**	**All[1]**	**Age, sex**	**All[1]**
Age	1.11***	1.08***	1.10***	1.08***
Self-Perceived Health				
Good	1.00	1.00	1.00	1.00
Fair/Poor/missing	1.49***	1.19	1.60***	1.42**
Living Arrangements				
Married	-	1.00	-	1.00
Not married, with others	-	1.12	-	1.03
Not married, alone	-	0.77	-	0.94
ADL Dependency				
Independent	-	1.00	-	1.00
Dependent	-	1.90***	-	1.46**
Incontinence				
Not incontinent	-	1.00	-	1.00
Incontinent of urine or Faeces	-	1.47*	-	1.21
Cognitive Impairment				
IO score 9-12	-	1.00	-	1.00
IO score 0-8	-	1.94**	-	2.01***

[1]Final model includes all covariates found to be statistically significant for either sex at either survey.

*$p<0.05$, **$p<0.01$, ***$p<0.001$

Table 5.8: Predicted mortality hazard ratio for less than good self-perceived health by age group from final model; participant interviewed at home

		1981		1988	
Sex	**Age**	**Risk Ratio**	**95% CI**	**Risk Ratio**	**95% CI**
Women	**75-81**	1.45	(1.03,2.09)	1.48	(1.04, 2.10)
	82-88	0.92	(0.57,1.49)	1.43	(0.99,2.06)
Men	**75-81**	1.77	(1.16, 2.71)	1.83	(1.25,2.69)
	82-88	2.99	(1.58, 5.66)	1.21	(0.77, 1.90)

Table 5.9: **Self-perceived health by survey; survivors interviewed at home in both 1981 and 1988**

		Self-perceived health, 1988			
Sex	**Self-perceived health, 1981**	**Good**	**Less than good**	**Institutionalised or dead**	**Total**
		n(%)	**n(%)**	**n(%)**	**n**
Women	**Good**	108 (24)	67 (15)	266 (60)	441
	Less than good	33 (11)	68 (22)	214 (68)	315
	Total n(%)	141 (19)	135 (18)	480 (63)	756
Men	**Good**	57 (25)	29 (13)	145 (63)	231
	Less than good	14 (10)	17 (12)	106 (77)	137
	Total n (%)	71 (19)	46 (13)	251 (68)	368

Figure 5.1: Predicted logodds of less than good self-perceived health, by age, cohort and ADL dependency from an additive model for women interviewed at home

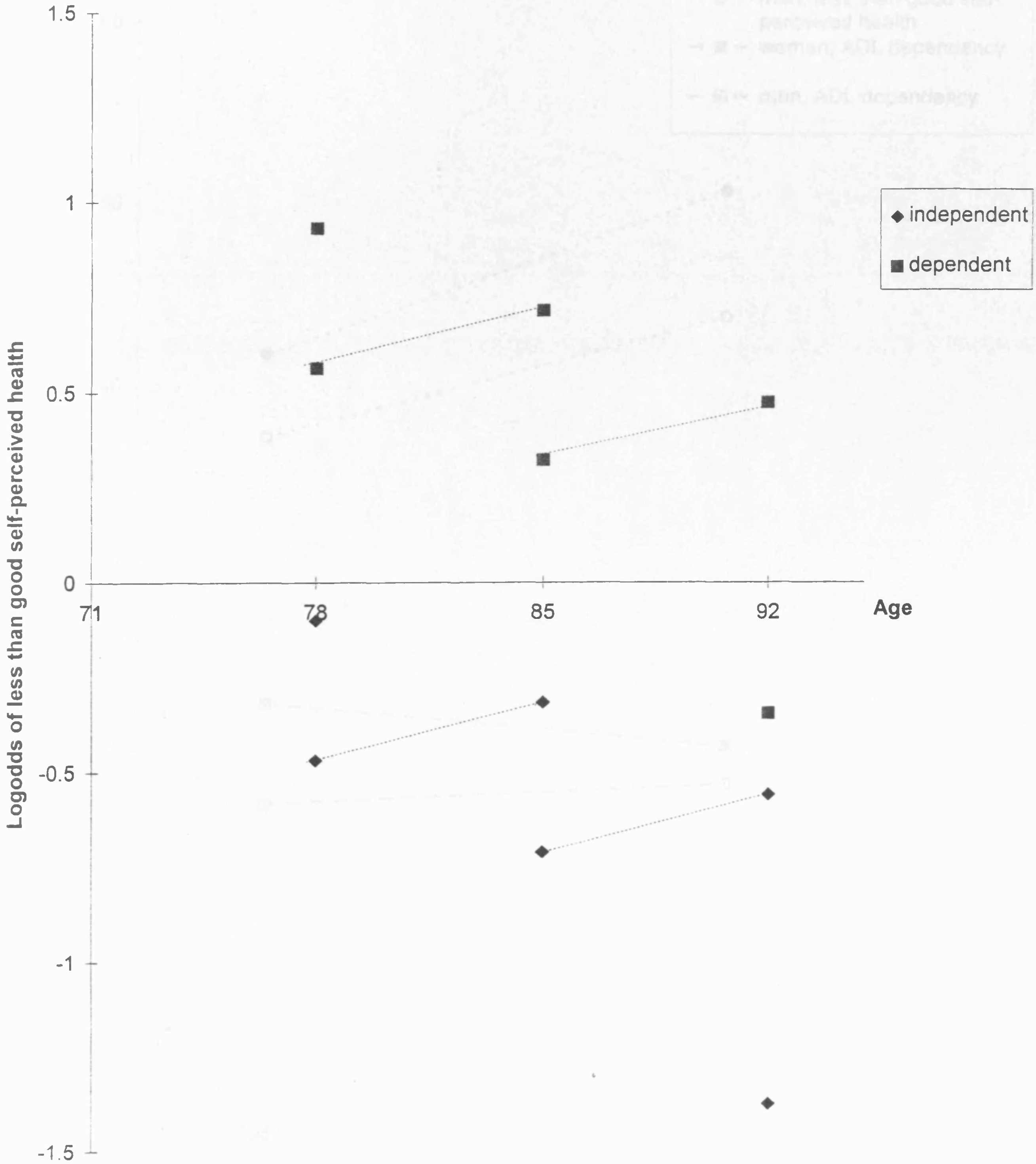


Figure 5.2: Less than good self-perceived health and ADL dependency: prevalence by sex and survey

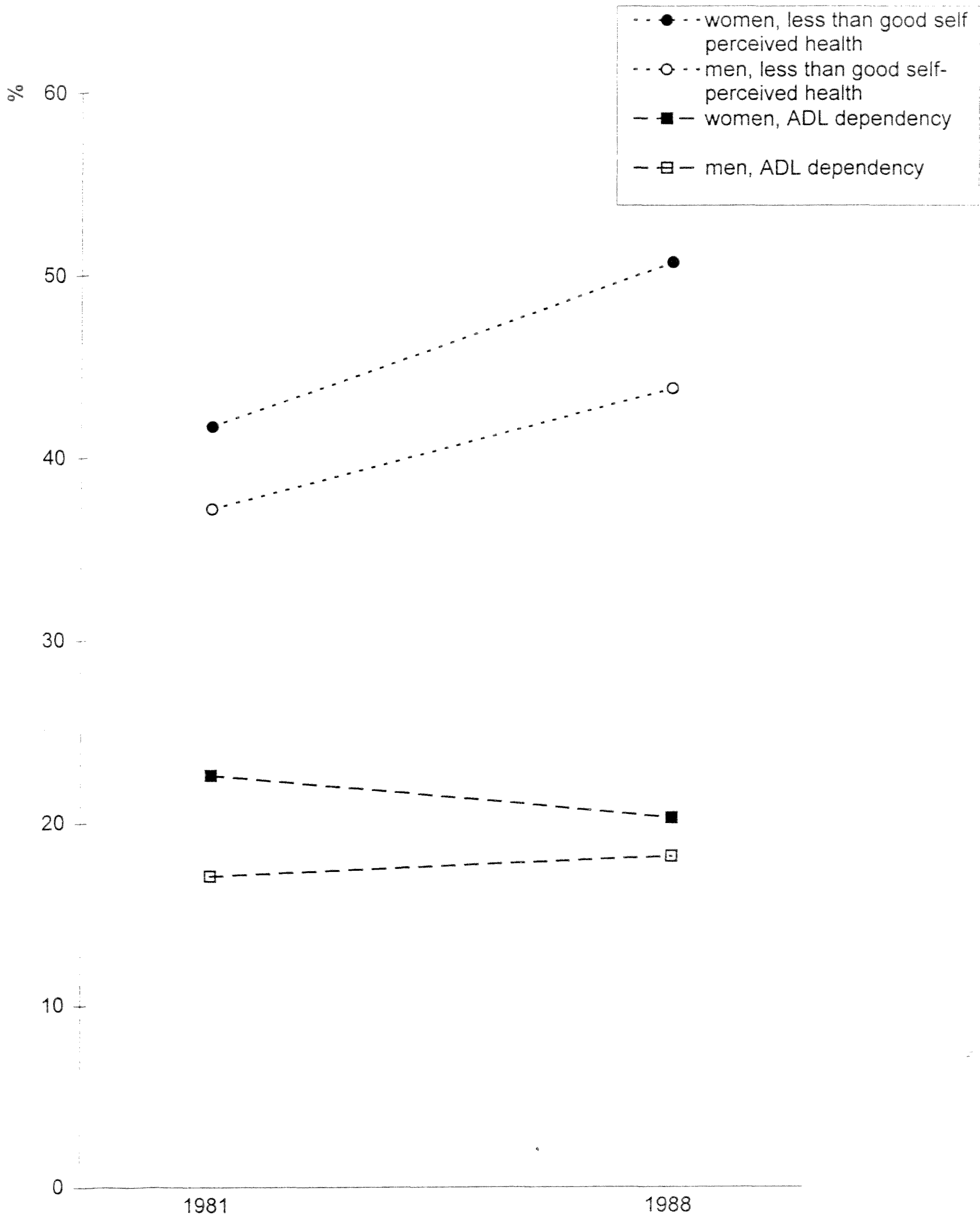


Figure 5.3: Percentage of women with less than good self-perceived health and number surveyed, by age (midpoint of age group) and cohort: community-based population

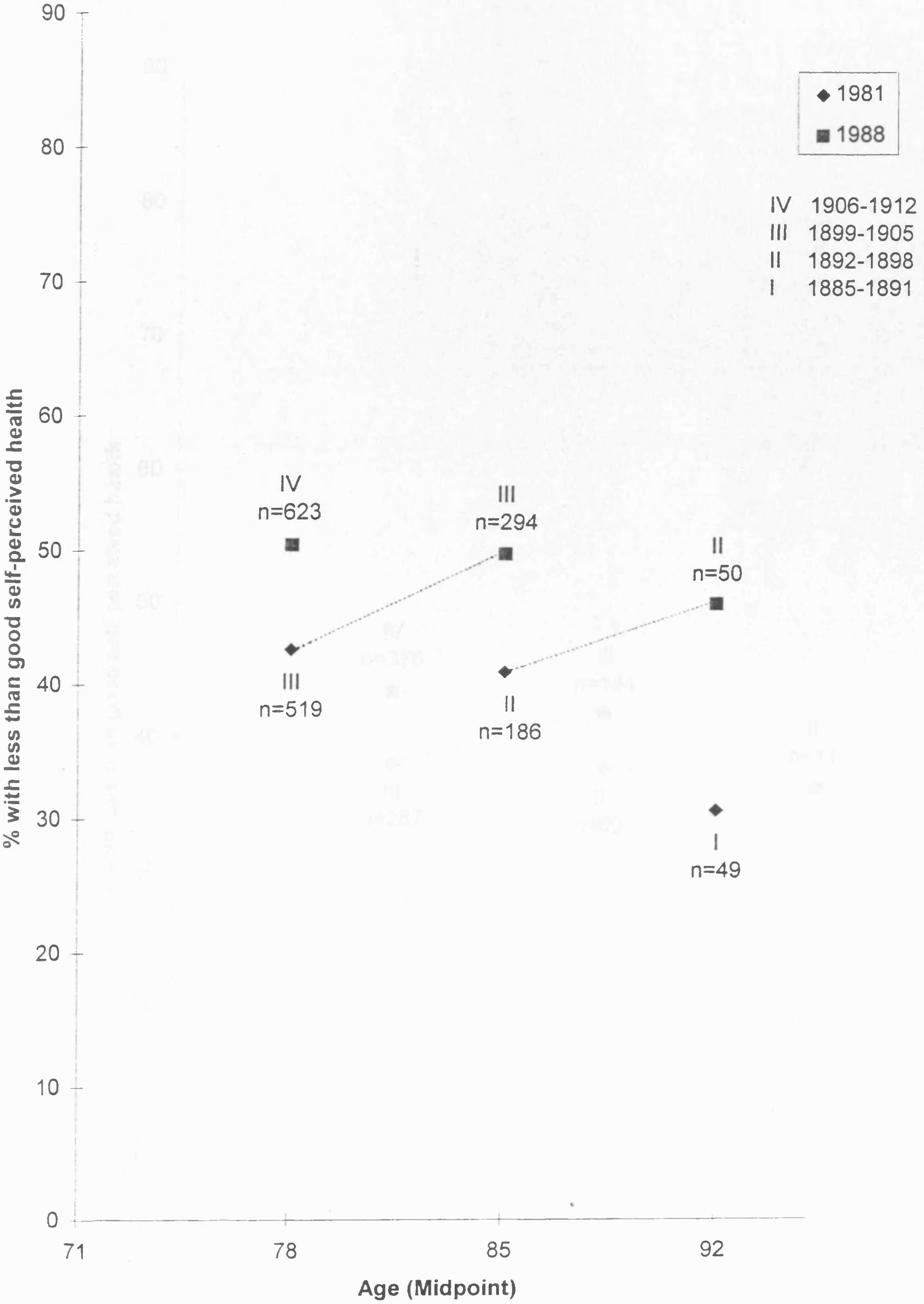


Figure 5.4: **Percentage of men with less than good self-perceived health and number surveyed, by age (midpoint of age group) and cohort: community-based population**

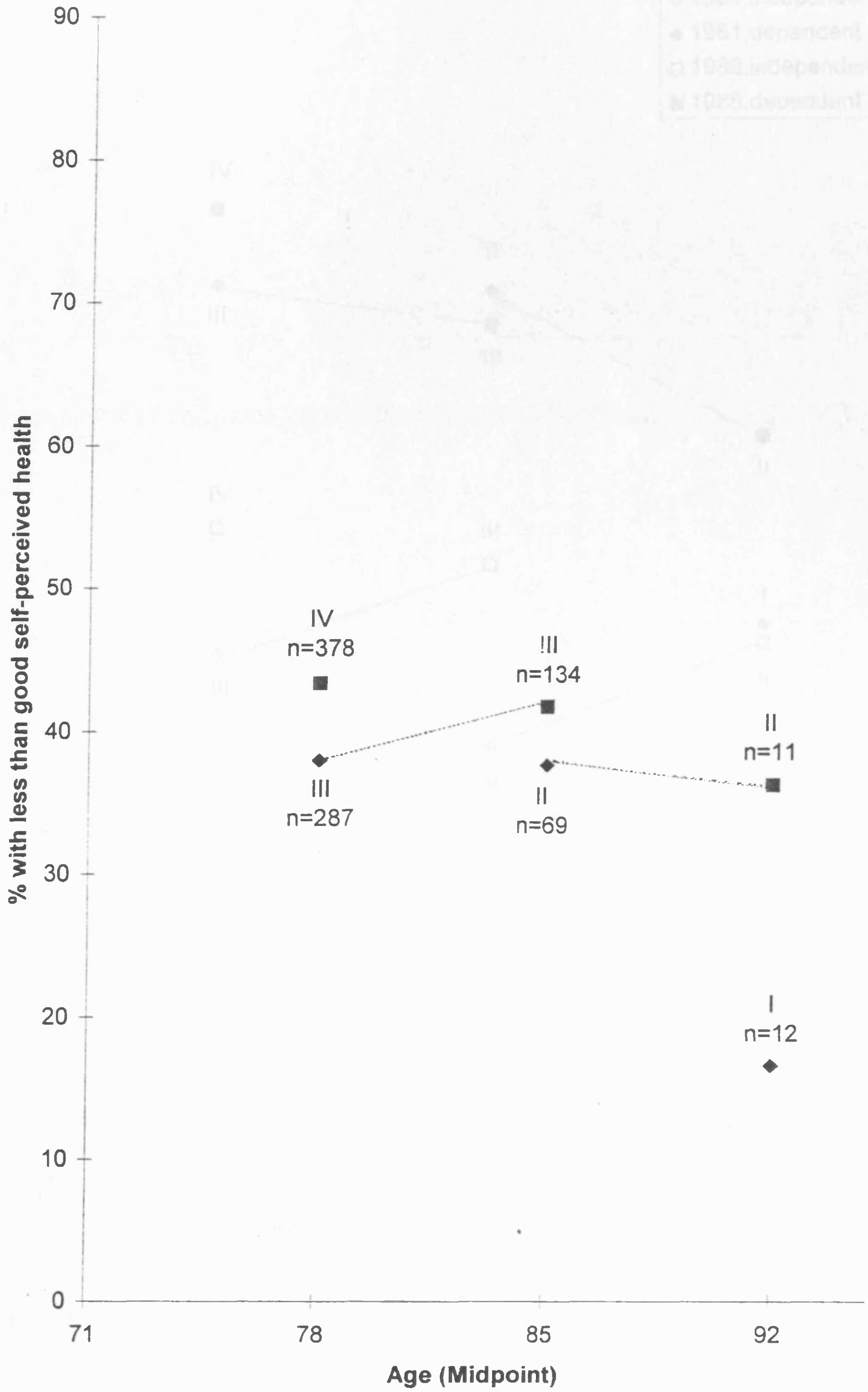
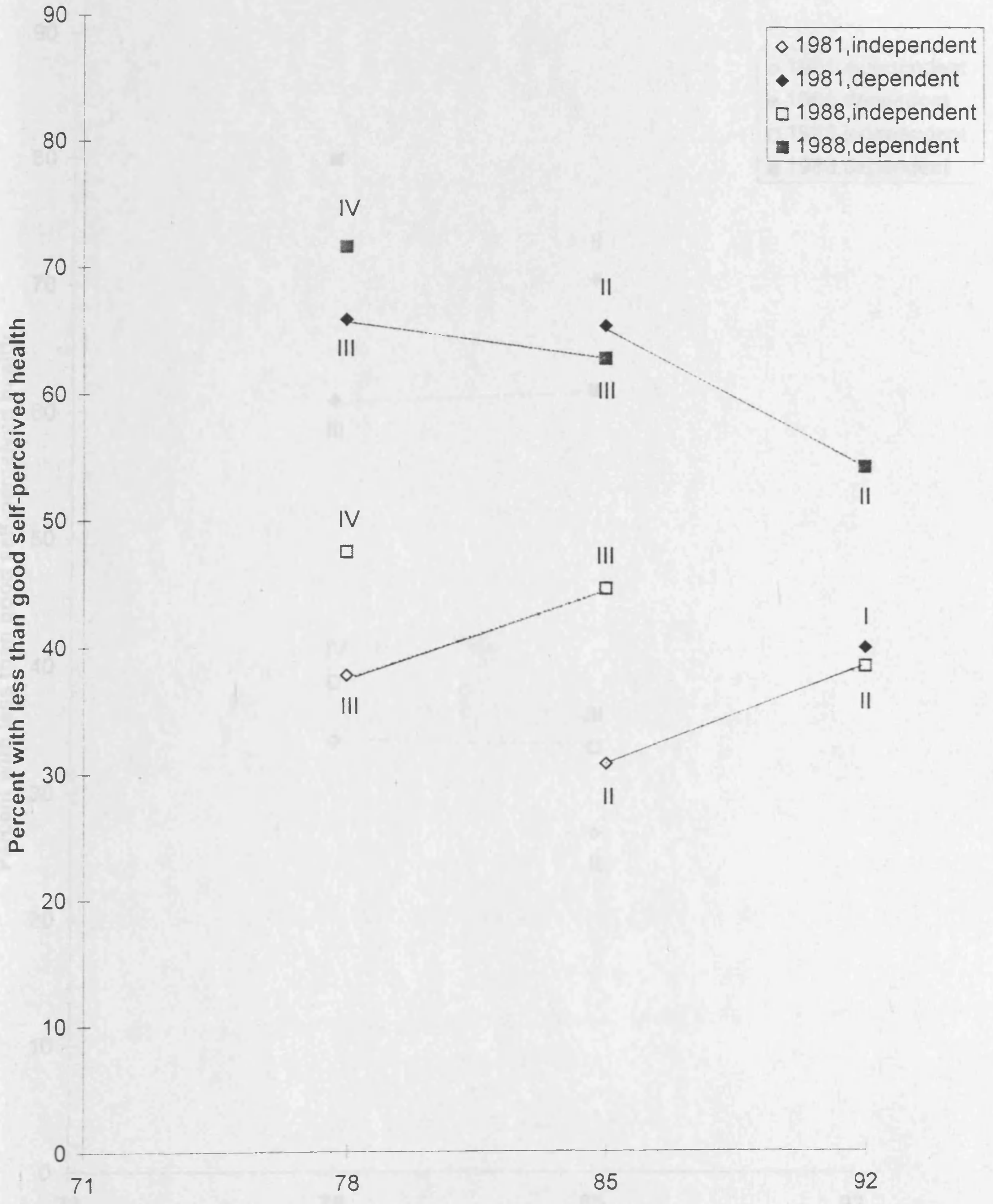
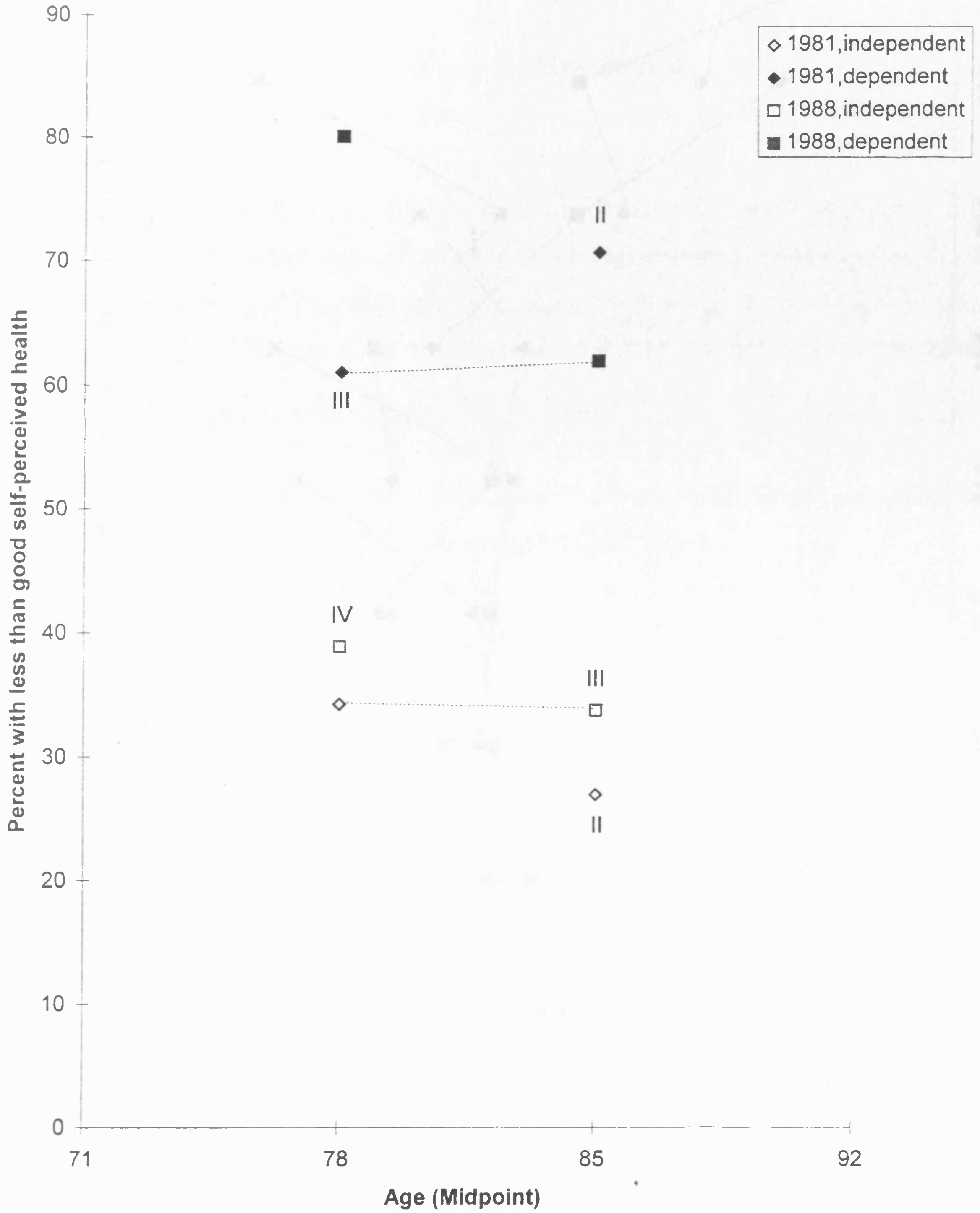


Figure 5.5: Percentage of women with less than good self-perceived health, by age (midpoint of age group), ADL dependency and cohort: community-based population



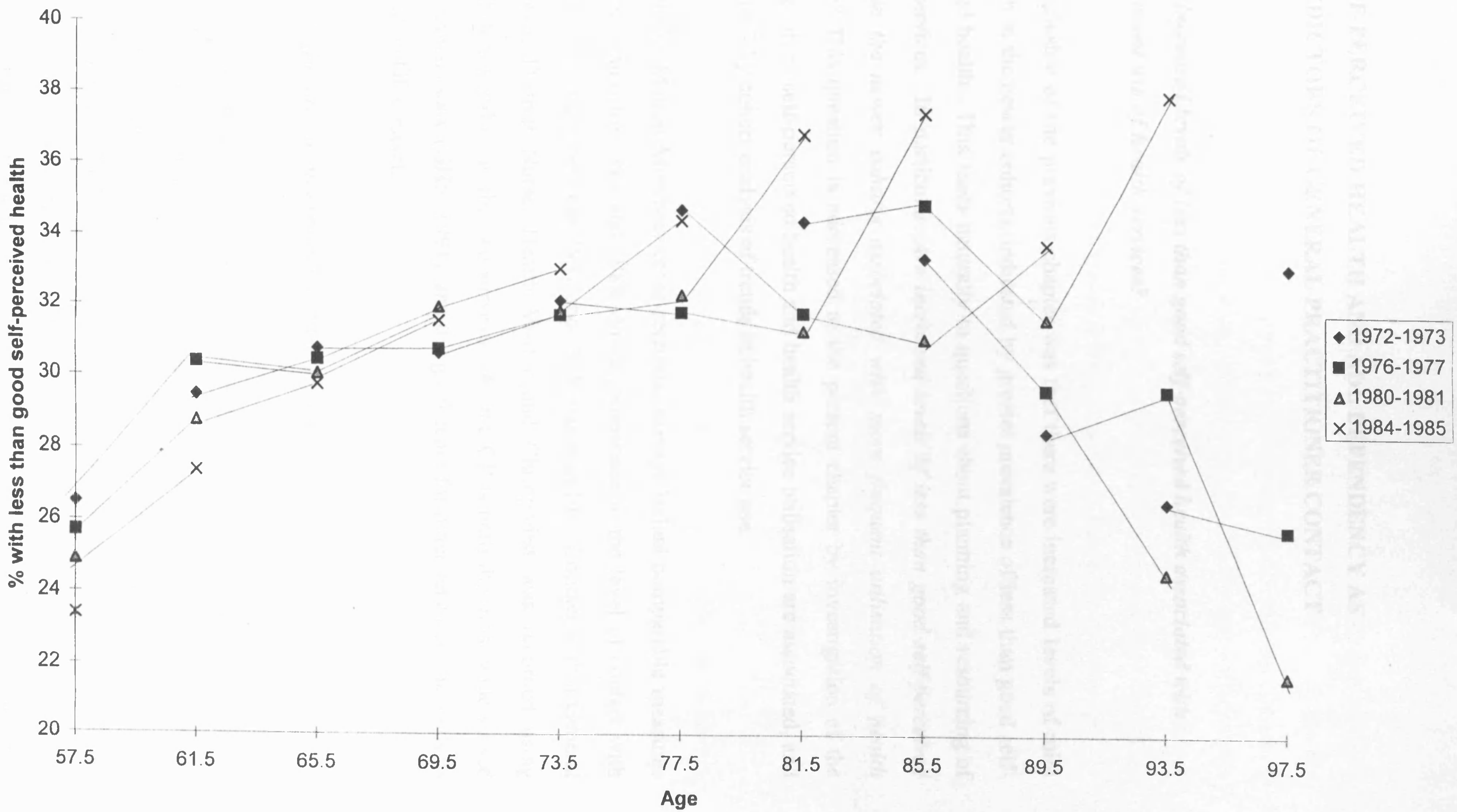
Dependency is defined as having help in at least one of mobility about the house, getting in and out of bed, getting in and out of a chair, dressing and feeding

Figure 5.6: Percentage of men with less than good self-perceived health, by age (midpoint of age group), ADL dependency and cohort: community-based population



Dependency is defined as having help in at least one of mobility about the house, getting in and out of bed, getting in and out of a chair, dressing and feeding

Figure 5.7: Percentage of the US population aged over 55 with fair or poor self-perceived health, from the Health Interview Survey



Source: Wolinsky, 1990 pp113

6. SELF-PERCEIVED HEALTH AND ADL DEPENDENCY AS PREDICTORS OF GENERAL PRACTITIONER CONTACT

6.1 Are increased levels of less than good self-perceived health associated with increased use of health services?

The conclusion of the previous chapter was that there were increased levels of mild ill-health in the newer cohorts, indicated by greater prevalence of less than good self-perceived health. This leads naturally to questions about planning and resourcing of health services. In particular: *Are increased levels of less than good self-perceived health in the newer cohorts associated with more frequent utilisation of health services?* This question is addressed in the present chapter by investigation of the extent to which self-perceived health and health service utilisation are associated, and in Chapter 7 by cohort analysis of trends in health service use.

Although the Melton Mowbray cross-sectional surveys lacked comparable measures of hospitalisation for 1981 and 1988, direct comparison in the level of contact with primary care services between 1981 and 1988 was possible. Contact with a General Practitioner, District Nurse, Health Visitor and Chiropodist was recorded using identical item wording at the two surveys. As the GP is both the most widely used form of primary care (GHS, 1991), and the gatekeeper for other services, the analysis focused upon GP contact.

6.2 Review of evidence on predictors of GP contact

Published work on primary care utilisation specific to the elderly population in the UK is quite limited, surveys with reasonable numbers aged 75 years and over being relatively scarce. Large UK studies reporting GP contact in populations aged over 65 years are summarised in Table 6.1. Although all of these surveys, except for the GHS, had at least one follow-up stage, most published analyses examine health service utilisation cross-sectionally. Older women are generally found to have slightly higher rates of contact with a GP than men, although the difference is small (Bowling 1989) and less marked than in younger adults (Haynes, 1991). Within the 65+ age group, there is a trend in the proportion contacting a GP with age, assessed cross-sectionally, with more contact in the older age groups (Victor and Vetter, 1986; Bowling, Farquhar and Browne, 1991). This age difference is consistent across subgroups by presence of chronic and disabling illness (Boniface and Denham, 1997). The GHS time series for contact with a GP in the past 14 days for people aged 75 years and over was stable through the 1980's with women having slightly higher risk of reported contact than men. Reported levels of contact peaked for men in 1990, but by 1992 had fallen below previous levels. From cohort analysis of the GHS time series, Jarvis (1998) reports cohort differences, with more recent cohorts reporting consultation more frequently. However, whilst cohort differences for men were observed across all age groups, for women the differences were only evident up to age 70 years.

The expected association between GP contact and morbidity is confirmed wherever measured. High levels of GP contact and measures of physical health have been found to be associated with symptom scores (Bowling, Farquhar and Browne, 1991), disability measured by the Townsend Index (Victor and Vetter, Bowling, Farquhar and Browne, 1991), and activity limitation (Cullen et al, 1993, Haynes, 1991). An exception is the sample aged 85 years and over in the Hackney survey where the association between functional ability and GP contact was not statistically significant, although people with low Townsend scores were the most frequent users of services (Bowling, Farquhar and Browne, 1991; Bowling and Grundy, 1997). In the follow-up to the London study, Bowling and Grundy found no association between GP contact and subsequent 2.5-3 year change in functional status.

GP contact has also been found to be positively associated with depression (Morgan et al, 1987; Cullen et al, 1993). Evidence is equivocal with regard to dementia; in the Gospel Oak study, elderly people with symptoms of dementia were less likely to have contact (Livingston et al, 1990). However no such relationship was found by Philp et al (1995) in a comparison of 144 age-sex matched pairs of demented and non-demented older people. GP contact has also been found to be related to psychological symptoms and emotional well-being, measured by the Neugarten Life Satisfaction score in the London and Essex survey (Bowling, 1989). The association between self-perceived health and GP contact was not examined in any of the UK studies reviewed. The GHS time series for contact with a GP in the past 14 days for people aged 75 years and over was stable through the 1980's, with women having slightly higher risk of reported contact than men. Reported levels of contact peaked for men in 1990, but by 1992 had fallen below previous levels. From cohort analysis of the GHS time series, Jarvis (1998) reports cohort differences, with more recent cohorts reporting consultation more frequently. However, whilst cohort differences for men were observed across all age groups, for women the differences were only evident up to age 70 years.

There is limited evidence of any relationship in the UK between GP contact and socioeconomic factors. Levels of contact remained similar in populations subdivided by social class (Dallosso et al, 1986; Haynes, 1991), and income or receipt of Supplementary Pension (Victor and Vetter, 1986). Bowling (1989) found no association between GP contact and marital status, type of network, perceived social support or reported feelings of loneliness, although the analysis, based upon contact in the past year, lacks power. Boniface and Denham (1997) report that older people who live alone were more likely to have seen a GP in the past two weeks.

Conclusions upon GP use of people aged 75 years and over from UK studies of primary care utilisation have been limited by relatively small sample sizes within this age group. Most reported analyses are bivariate, and do not allow exploration of multiple determinants of GP contact. Health Service Utilisation has been much more extensively studied in the US, but comparisons are limited by differences in systems of health care delivery. For example, barriers to access may be of less relevance in the UK where access to a GP is free to all who have registered. Moreover, US studies of physician contact typically aggregate contact with a primary care physician and contact with a specialist. Nevertheless, given the extent of research undertaken, US literature provides a useful point of reference.

Whilst UK studies of GP contact are generally not explicitly theorised, the majority of US large-sample work on physician utilisation is within the framework of Andersen's behavioural model (Andersen and Newman, 1973). The main components of the model are predisposing, enabling and need characteristics, illustrated in Figure 6.1. The Andersen model has been criticised, particularly by Mechanic (1979), for "neglect of the social-psychological process through which physical health is perceived, evaluated and acted upon". This critique reflects the limitations of large-scale quantitative research designs, and alternative models, such as Rosenstock's health belief model (Krause, 1990; Rosenstock, 1974) and models operationalising barriers to care (Baker and Pallett-Hehn, 1995) are more suited to qualitative research.

A review of North American studies of health service utilisation published between 1980 and 1985 is given by Wan (1989). Contact with a physician or number of physician visits was included as a dependent variable in fourteen of the studies reviewed. In each case the amount of variation in health service utilisation explained was quite small, and most of this variation was attributable to need for care, as opposed to predisposing or enabling factors. Measures of need in this context can be broadly classified into self-perceived health, ADLs or activity limitations, self-reported symptoms or conditions, acute illness episodes and self-perceived need for services. Self-perceived health was a statistically significant predictor of physician use in ten studies. In the remaining four, self-perceived health was not measured.

Although time ordering is implicit in the Andersen framework, in most studies the framework has been applied cross-sectionally, and it is recognised (for example, Wolinsky and Arnold, 1988) that such studies have not been successful in explaining physician contact beyond the rather obvious finding that people seek help from a doctor when they feel ill. Even the analysis of the Longitudinal Study on Ageing by Wolinsky and Johnson (1991) with more than twenty covariates accounted for, explained only 17% of the between person variation in number of physician visits. Recent studies have attempted to develop the Andersen framework by taking a longitudinal perspective (for example, Mossey Havens and Wolinsky 1989; Callahan et al, 1994), examining interactions, in particular differences in predictors of physician use by sex (Mutran and Ferraro, 1988; Krause, 1996), or focus upon psychosocial predictors (Strain, 1991).

The association between single-item self-perceived health and GP contact has not been specifically explored in the UK, although Ebrahim, Hedley and Sheldon (1984) reported that people aged over 65 years who had not consulted their GP in the past eighteen months had significantly higher Nottingham Health Profile scores. Higher levels of contact amongst older people who are in less than good health are to be expected. This chapter will examine both association between self-perceived health and GP contact, and the extent to which this relationship varies by sex, age group and cohort. In addition, a comparison will be drawn between self-perceived health and ADL dependency as predictors of GP contact in the population aged over 75 years.

6.3 Measures and summary of rates of contact

Contact with a GP is defined in three ways, each measured by self-report: any contact with a GP in the past week, any contact in the past month, and any contact in the past year. Contact includes home and surgery visits, but not telephone consultations. Trends in prevalence of GP contact may reflect availability of GPs at the practice, however, information on the level of staffing in 1981 and 1988 is not available. A partner employed by the practice throughout the period of the study confirms that some telephone consultation has always taken place, but the level of telephone contacts is unknown. The validity of self-reported contact with a GP is supported by the findings of Glandon, Counte and Tancredi (1992), who investigated the accuracy of self-reported physician use in a survey of volunteers aged over 60 years in Chicago. Although there was systematic under and over reporting of the number of visits made, more than 90% of the population were able to report physician contact in the past six months accurately. Results presented here concentrate upon contact with a GP in the past month, with some additional consideration of contact with a GP in the past year. Analyses of contact in the past week produced results which were similar to those for contact in the past month, but with less clear evidence for differences, because of the relatively small numbers with such recent contact.

Prevalence of GP contact by gender and survey is summarised in Figures 6.2 and 6.3. Roughly 10% of the population had contacted their GP in the past week, rising to around three-quarters who reported contact in the past year. Whilst there was an increase in the proportion of men who had contacted the GP between the two surveys, there was little or no such increase amongst the female subpopulation; indeed the proportion of elderly women who had seen a GP in the past year was less in 1988 than in 1981. The increased level of contact amongst the men in 1988 in Melton was such that men were more likely to be seen in the past month in 1988 than women. This finding contradicts to much of the UK and international literature, where women have typically been found to make more use of primary care (for example, Wolinsky and Johnson, 1991; Slivinske, Fitch and Mosca, 1994; Doty, 1987), although this difference may be slight (Mutran and Ferraro, 1988).

6.4 Predictors of contact with a GP in the past month - strategy for logistic regression

Logistic regression was used to assess the strength of the association between GP contact and self-perceived health and ADL dependency. The aim is to compare the pattern of associations across cohorts and surveys, with particular focus upon associations of self-perceived health and ADL dependency with GP contact. The analysis is repeated by sex, cohort and survey, so that eight regressions are reported in all (Table 6.2). The approach of separate regressions by subgroup was chosen in preference to including interaction terms by age and sex. Although this leads to multiple analyses, it is attractive for an exploratory analysis of these data because it allows qualitative comparisons of the predictors of GP contact between subgroups whilst avoiding some of the model complexity associated with statistical tests for interactions. However, statistical power is somewhat limited by this approach. Statistically significant differences between the magnitude of associations in different age groups are established where confidence intervals do not overlap.

Although intercohort differences in the strength of the various associations are explored, the analysis in this chapter is essentially cross-sectional, examining a snapshot of each cohort by gender at one or two timepoints. The models cannot be expected to fully explain GP contact and cannot attribute causation. 'Predictors' of GP contact are measured after the contact had occurred, so associations will be weakened by subsequent change, or may alternatively be strengthened, if the experience of seeing a GP itself has an effect upon the covariate. As an example, the association between GP contact and self-perceived health could be directed two ways, with high levels of less than good self-perceived health in the men aged 75-81 years in 1988 being partly explained by the fact that these men are seeing the doctor more. Cross-sectional analyses are powerless to unscramble this conundrum, but the seven-year interval between surveys does not allow for useful longitudinal analysis. The present approach offers a positive step beyond the cross-sectional framework, allowing exploration of systematic differences in the pattern of predictors of GP contact by sex, birth cohort and age.

In the main analysis, the dependent variable was contact with a GP in the past month. As well as crude comparisons of the prevalence of GP contact by self-perceived health status, odds ratios were calculated with adjustment for potential confounders. Adjustment was made in three stages. Initially, variables relating to socioeconomic factors and living arrangements were included in the model. Then these variables were removed and variables relating to health status were included. Finally, all the potential confounders were included in a single model. For clarity, results are presented here for the crude comparisons and for the full model.

6.5 Predictors of contact with a GP in the past month - men

Rates of GP contact for men by age, cohort and self-perceived health are given in Table 6.3. Less than good self-perceived health was most strongly associated with higher levels of GP contact in the most recent seven-year cohort, interviewed aged 75-81 years in 1988. The expected association with self-perceived health was also observed amongst men born in 1899-1905, both aged 75-81 years in 1981, and again when the survivors were interviewed in 1988. However, amongst men aged 82-88 years in 1988, born in 1892-1898, rates of GP contact were slightly higher in men with good self-perceived health. In contrast to self-perceived health, ADL dependency was associated with higher rates of GP contact amongst the cohorts born 1892-1898 and 1899-1905, but not in the cohort born 1906-1912 (Table 6.4).

Odds ratios for GP contact by self-perceived health and ADL dependency for men are given in Tables 6.5 and 6.6. Small numbers of men in the cohorts aged 82-88 years meant that meaningful adjusted analysis was impossible. In the 75-81 year age group, none of the other covariates included showed evidence of association with GP contact that was anywhere near statistical significance. As expected, GP contact for men is predicted primarily by measures of need. Focusing initially upon men aged 75-81 years in 1981 (Table 6.5), self-perceived health was an independent predictor of GP contact, but this association was only statistically significant in the case of the comparison between the relatively few men (n=26) whose health was poor, and their peers with good self-perceived health. ADL dependency was also a statistically significant predictor of GP contact, and ADL dependency and self-perceived health were independent of one another as predictors. This pattern of associations was closely reproduced in the results for the survivors from this cohort interviewed, aged 82-88 years, seven years later (Table 6.6) . Returning to Table 6.5, conclusions regarding the men aged 82-88 years in 1981 are limited by the relatively small sample size, but again the impression was of self-perceived health and ADL dependency as both moderately strong predictors of GP contact. Strengthening of the association between ADL dependency in the full model was attributable to adjustment for socioeconomic factors, but interpretation is difficult because the numbers in subgroups were very small.

As in the previous analyses, results for men aged 75-81 years in 1988 were rather different from those in the other cohorts. For this group, self-perceived health was a strong statistically significant independent predictor of GP contact, for men in both fair and poor self-perceived health. Moreover, in this elderly cohort, in contrast to preceding cohorts, ADL dependency was not associated with greater risk of GP contact and, once self-perceived health was included in the model, ADL dependency is associated with significantly *less* GP contact. Whilst associations with contact in the past year were somewhat less strong than those for contact in the past month, the pattern of associations was similar, with stronger association between GP contact and self-perceived health in 1988 than in 1981.

6.6 Predictors of contact with a GP in the past month - women

Less than good self-perceived health was associated with increased levels of GP contact for women, but this association was not so strong as for the men (Table 6.7). Moreover, the strength of the association between self-perceived health and GP contact in women aged 75-81 years was comparable in 1981 and 1988. This was confirmed in the logistic regression analysis (Tables 6.9 and 6.10). In contrast to the men, the women in the 1906-1912 cohort appeared consistent with preceding cohorts in terms of the relationship between GP contact and self-perceived health. There was some suggestion that the association between GP contact and self-perceived health in the 1899-1905 and 1892-1898 cohorts strengthened as the cohorts age, but the confidence intervals were wide. As in the male population, GP contact was less consistently associated with ADL dependency than with self-perceived health.

In contrast to the men, predictors of GP contact for the women were not confined to indicators of need. There was consistent evidence across the subgroup analyses that women who are not married but live with others were less likely to see a GP than those who were married, regardless of health status. Associations with reported difficulty managing on income and incontinence were also statistically significant in certain subgroups. Comparison of corresponding odds ratios by gender suggests that the presence of more statistically significant associations for women is due to substantial differences in the magnitudes of odds ratios, rather than increased sample size in the female population.

6.7 Conclusions and discussion

Self-perceived health is confirmed as a moderately strong predictor of physician contact in an elderly UK population, across subgroups by sex, age and survey. More interestingly, this association is particularly strong amongst men aged 75-81 years in 1988. Whilst the risk of contact for those in less than good self-perceived health compared to those in good self-perceived health is multiplied by approximately 1.5 times in most cohorts, in men aged 75-81 years in 1988, the relative risk is 2.4. (95% confidence interval 1.7 to 3.3), translating into an odds ratio of 3.9. The fact of a much stronger association in the 75-81-year-olds in 1988 is maintained in analysis with adjustment for socioeconomic and health status.

Increased strength of the association between GP contact and self-perceived health amongst the new elderly men compared to their precursors is not matched in the female population. For women, the association between fair and poor self-perceived health and GP contact is close to identical for 75-81 year olds in 1981 and 1988, raising the possibility that different mechanisms may underlie the association of self-perceived health and GP contact in male and female populations.

Stronger association between GP contact and self-perceived health in 1988 may be explained by increased rates of contact amongst men with less than good self-perceived health, or decreased rates of contact amongst those in good self-perceived health, with these changes being themselves related either to changes in prevalence of underlying health problems, or to systematic changes in the individual thresholds at which the distinction between good and fair or poor self-perceived health is drawn. Since this set of possible explanations hinges upon changes in prevalence of GP contact, further discussion is reserved until after results of the cohort analysis of GP contact in Chapter 7.

A further difference between men and women with regard to predictors of GP contact was evidence of a wider range statistically significant predictors, including measures not directly related to need, for the women. Systematic differences between men and women with respect to self-perceived health as a predictor of physician use have also been reported by Mutran and Ferraro (1988). In a national US sample of people aged 65 years and over of low and middle-income, a statistically significant interaction of gender and self-perceived health upon physician contact was found, with the association of poor self-perceived health with recency of physician visits being stronger for men than for women.

Two interlinked mechanisms may be at work here. Firstly, there may be systematic differences between men and women in attribution of self-perceived health. Secondly, there may be a substitution effect. Krause (1996) suggests that women are more likely to access informal care from relatives and friends in order to deal with health problems. In this scenario, risk contact with formal services may depend upon availability of informal care. Accessing informal care may be less customary for married women, and this may go some way towards explaining their higher rates of GP contact than women who are not married but live with others, usually including a female relative or close female friend.

The strength of the association between ADL dependency and GP contact varies by age and sex, and in some cases ADL dependency is only a very weak predictor of GP contact. These inconsistencies may be accounted for within the framework of the Andersen model, as dependency may be viewed both as a disenabling factor, and a measure of need, these two aspects having contradictory implications. To confound matters further, the disenabling influence of dependency applies largely, if not exclusively to surgery visits. A positive association between ADL dependency and home visits may be outweighed by negative association between ADL dependency and visits to the surgery. This hypothesis is supported by Iliffe et al (1993), who looked at home visits only in a UK population, and found very strong statistically significant associations with dependency defined either as needing help with bathing or as needing help going up or down stairs. It might, therefore, be expected that ADL dependency would act more strongly as a disenabling factor in 1988 than in 1981, and this suggestion is supported by weakening of the association between ADL dependency and GP contact, at least for people aged 75-81 years. Moreover, people with mobility problems may be more likely to consult by telephone, in which case the levels of GP contact in the dependent group would systematically understate need. The picture may be further confounded by changes in enabling factors, such as greater availability of informal care and transport to the surgery in 1988.

ADL dependency has been reported to be a significant predictor of physician visits in a number of the US studies (Wan, 1989). Research in the UK has tended to support an association between dependency and GP use, although with some qualifications. In the Hackney study, GP contact was unrelated to ADL disability in the sample aged 85+ years, although there was such a relationship in the sample aged 65-84 years (Bowling, Farquhar and Browne, 1989), so it is possible that the relationship is less strong among the very old. The strength of the association may also depend upon the time window allowed to define contact. Ebrahim et al (1984) found strong association between GP consultation in the past 18 months and being unable to go out of doors alone and also with incontinence.

Whilst the extent to which the differences in the pattern of predictors of GP contact between male and female populations and across the age groups is generalisable is open to question, it seems that, as a group, the men aged 75-81 years in 1988 exhibit unusual patterns of self-reported health and GP contact. On average, compared to his counterpart in 1981, a man aged 75-81 years in 1981 was more likely to have less than good self-perceived health, and this deficit was more likely to be associated with a recent contact with his GP. It follows that, as a group, these elderly men in 1988 will have substantially higher levels of GP contact, and this intercohort difference is explored in more detail in the next chapter.

6.8 Summary

Statistically significant predictors of GP contact in the past month were identified using logistic regression analysis, with men and women analysed separately by seven-year birth cohort and age group. Models fitted included covariates for difficulty managing on income and living arrangements, self-perceived health, ADL dependency and incontinence. Self-perceived health was an independent predictor of GP contact in each analysis, with adjusted odds of contact being over twice as large for elderly people who rated their health as poor, compared to those with good self-perceived health. The association between self-perceived health and GP contact was particularly strong amongst men in the 1906-1912 birth cohort, aged 75-81 years when interviewed in 1988. The difference in the magnitude of the association between GP contact and self-perceived health men aged 75-81 years in 1981 and 1988 was statistically significant, whilst in women, the corresponding difference was negligible. There was also some evidence that the set of predictors of GP contact differs systematically by gender.

Associations between ADL dependency and GP contact were inconsistent across subgroups by age, cohort and gender, probably reflecting differences in the extent to which ADL dependency operates as a disenabling factor, as distinct from an indicator of need. ADL dependency was generally less closely associated with GP contact than self-perceived health.

Table 6.1: **Published studies reporting GP use in UK populations aged over 65 years**

Data Source	Location	Date	Age Threshold	Sample 65-74	Sample 75+	Measure of GP Use	Reference(s)
GHS	Great Britain	1982	-	2884	1581	Contact in past two weeks	Victor and Vetter, 1986
Nottingham Longitudinal Study of Activity and Ageing (NLSAA)	Nottingham	1985	65	507	535	Contact in past month	Dallosso et al, 1986, Morgan et al, 1987
	London and Essex	1987-9	65	1415 aged 65+		Contact in past year	Bowling, Farquhar and Browne, 1991
Gospel Oak	Camden, London	1987	65	705 aged 65+		Contact in past month	Cullen et al, 1993
Health and Lifestyle Survey	NW Thames Region	1990-1	-	1002	836	Contact in past two weeks	Boniface and Denham, 1997

Table 6.2: Subgroups for logistic regression analysis, with numbers included

	Men		Women	
Age	**1981**	**1988**	**1981**	**1988**
	Included in Regression (Number Interviewed)	**Included in Regression (Number Interviewed)**	**Included in Regression (Number Interviewed)**	**Included in Regression (Number Interviewed)**
75-81	263-284[1]	365-376	455-508	588-618
	(287)	(378)	(519)	(623)
82-88	62-68	130-134	161-178	275-290
	(69)	(134)	(186)	(294)

[1] Numbers vary because of missing covariate values

Table 6.3: Percentage of men with GP contact in the past month, by age, cohort and self-perceived health

Year of Survey		1981			1988		
Self-perceived health		good % (base)	less than good % (base)	Odds ratio	good % (base)	less than good % (base)	Odds ratio[2]
Cohort	**Age at 31.12.80**						
1906-1912	**68-74**	-	-	-	21 (211)	51 (164)	3.9
1899-1905	**75-81**	23 (178)	36 (109)	1.9	30 (76)	45 (56)	1.9
1892-1898	**82-88**	26 (43)	23 (26)	0.9	-[1]	-[1]	-

[1] n less than 10

[2] Ratio of odds of contact in the past month for less than good:good self-perceived health

Table 6.4: Percentage of men with GP contact in the past month, by age, cohort and ADL dependency

Year of Survey		1981			1988		
ADL Dependency		Independent in ADL	Dependent in ADL	Odds ratio	Independent in ADL	Dependent in ADL	Odds ratio
		% (base)	% (base)		% (base)	% (base)	
Cohort	**Age at 31.12.80**						
1906-1912	**68-74**	-	-	-	34 (330)	33 (48)	1.0
1899-1905	**75-81**	25 (246)	44 (41)	2.4	31 (91)	49 (43)	2.1
1892-1898	**82-88**	23 (53)	31 (16)	1.5	-[1]	-[1]	-

[1]n less than 10

Table 6.5: Odds ratios for GP contact by self-perceived health and ADL dependency, men aged 75-81 years and 82-88 years, surveyed in 1981

Age	75-81		82-88
	Crude	Adjusted	Crude
	OR(95% CI)[2]	OR(95% CI)[1]	OR(95% CI)
Self-Perceived Health			
Good	1.0	1.0	1.0
Fair	1.5 (0.8, 2.7)	1.4 (0.7,2.5)	0.7 (0.1, 2.5)
Poor	3.6 (1.4, 1.9)*	2.8 (1.0, 7.5)*	2.9 (0.3, 23.3)
ADL Dependency			
Independent	1.0	1.0	1.0
Dependent	2.5 (1.2, 5.1)*	2.5 (1.1, 5.5)*	1.7 (0.4, 6.0)
Living Arrangements			
Married	1.0	1.0	1.0
Not married, with others	1.0 (0.3, 2.6)	1.1 (0.4, 3.0)	3.0 (0.8, 11.2)
Alone	0.8 (0.4, 1.7)	0.8 (0.4, 1.7)	1.1 (0.2, 4.9)
Difficulty managing on present Income			
No difficulty	1.0	1.0	1.0
Difficulty	1.3 (0.7, 2.6)	1.2 (0.6, 2.4)	1.3 (0.2, 5.3)
Incontinence			
Not incontinent	1.0	1.0	1.0
Incontinent of urine or faeces	0.7 (0.2, 1.9)	0.4 (0.1, 1.3)	1.2 (0.2, 5.0)

[1] Model includes main effects for difficulty managing on income and living arrangements, self-perceived health, ADL dependency and incontinence

[2] Asterisk indicates 95% confidence interval for odds ratio does not include [1]

Table 6.6: **Odds ratios for GP contact by self-perceived health and ADL dependency, men aged 75-81 years and 82-88 years, surveyed in 1988**

Age	**75-81**		**82-88**
	Crude	**Adjusted**	**Crude**
	OR(95% CI)[2]	**OR(95% CI)[1]**	**OR(95% CI)**
Self-Perceived Health			
Good	1.0	1.0	1.0
Fair	3.4 (2.1, 5.5)*	3.9 (2.3, 6.5)*	1.5 (0.6, 3.6)
Poor	6.1 (2.7, 13.5)*	8.5 (3.5, 20.3)*	2.5 (0.9, 6.6)
ADL Dependency			
Independent	1.0	1.0	1.0
Dependent	1.0 (0.5, 1.9)	0.5 (0.2, 1.1)	2.1 (1.0, 4.6)*
Living Arrangements			
Married	1.0	1.0	1.0
Not married, with others	1.1 (0.4, 2.5)	1.3 (0.5, 3.3)	1.4 (0.4, 4.3)
Alone	1.2 (0.7, 2.0)	1.2 (0.6, 2.0)	0.7 (0.3, 1.6)
Difficulty managing on present Income			
No difficulty	1.0	1.0	1.0
Difficulty	1.0, (0.5, 1.8)	0.8 (0.4, 1.5)	0.8 (0.3, 1.7)
Incontinence			
Not incontinent	1.0	1.0	1.0
Incontinent of urine or faeces	1.3 (0.6, 2.7)	1.0 (0.4, 2.3)	3.8 (1.3, 11.1)*

[1] Model includes main effects for difficulty managing on income and living arrangements, self-perceived health, ADL dependency and incontinence

[2]Asterisk indicates 95% confidence interval for odds ratio does not include [1]

Table 6.7: Percentage of women with GP contact in the past month, by age, cohort and self-perceived health

Year of Survey		1981			1988		
Self-perceived health		good	less than good	Odds ratio	good	less than good	Odds ratio[2]
		% (base)	% (base)		% (base)	% (base)	
Cohort	**Age at 31.12.80**						
1906-1912	**68-74**	-	-	-	25 (306)	38 (314)	1.8
1899-1905	**75-81**	26 (297)	39 (221)	1.8	22 (145)	35 (146)	1.9
1892-1898	**82-88**	18 (109)	34 (76)	2.3	12 (27)	43 (23)	5.5
1885-1891	**89-95**	42 (33)	20 (15)	0.3	-[1]	-[1]	-

[1]n less than 10

[2] Ratio of odds of contact in the past month for less than good:good self-perceived health

Table 6.8 **Percentage of women with GP contact in the past month, by age, cohort and ADL dependency**

Year of Survey		1981			1988		
ADL Dependency		Independent in ADL	Dependent in ADL	Odds ratio	Independent in ADL	Dependent in ADL	Odds ratio
		% (base)	% (base)		% (base)	% (base)	
Cohort	Age at 31.12.80						
1906-1912	68-74	-	-		32 (541)	29 (82)	0.9
1899-1905	75-81	30 (430)	35 (88)	1.3	25 (206)	39 (87)	1.9
1892-1898	82-88	21 (130)	30 (56)	1.6	23 (26)	29 (24)	1.4
1885-1891	89-95	30 (23)	35 (26)	1.3	-[1]	-[1]	

[1]n less than 10

Table 6.9: Odds ratios for GP contact by self-perceived health and ADL dependency, women aged 75-81 years and 82-88 years, surveyed in 1981

Age	75-81		82-88	
	Crude Odds Ratio[2]	Odds Ratio from Full Model[1]	Crude Odds Ratio	Odds Ratio from Full Model[1]
Self-Perceived Health				
Good	1.0	1.0	1.0	1.0
Fair	1.7 (1.1, 2.6)*	1.7 (1.2, 2.7)*	1.8 (0.8, 3.9)	1.3 (0.5, 3.2)
Poor	2.1 (1.1, 4.4)*	2.6 (1.1, 6.1)*	4.4 (1.5, 12.7)*	2.8 (0.8, 9.3)
ADL Dependency				
Independent	1.0	1.0	1.0	1.0
Dependent	1.2 (0.7, 2.1)	1.4 (0.7, 2.4)	1.7 (0.8, 3.4)	1.2 (0.5, 2.7)
Living Arrangements				
Married	1.0	1.0	1.0	1.0
Not married, with others	0.5 (0.2, 0.9)*	0.4 (0.2, 0.8)*	0.4 (0.1, 1.6)	0.3 (0.0, 1.2)
Alone	1.0 (0.6, 1.6)	1.1 (0.7, 1.8)	1.1 (0.1, 1.3)	0.2 (0.0, 0.9)*
Difficulty Managing on Present Income				
No difficulty	1.0	1.0	1.0	1.0
Difficulty	1.3 (0.8, 2.1)	1.2, (0.7, 2.0)	3.7 (1.4, 9.4)*	3.6, (1.3, 10.0)*
Incontinence				
Not incontinent	1.0	1.0	1.0	1.0
Incontinent of urine and faeces	0.5 (0.2, 1.0)*	0.4 (0.1, 1.0)*	1.8 (0.7, 4.4)	1.8 (0.6, 5.0)

[1] Full model includes main effects for social class, difficulty managing on income and living arrangements, self-perceived health, ADL dependency, visual and hearing impairment and incontinence

[2] Asterisk indicates 95% confidence interval for odds ratio does not include unity

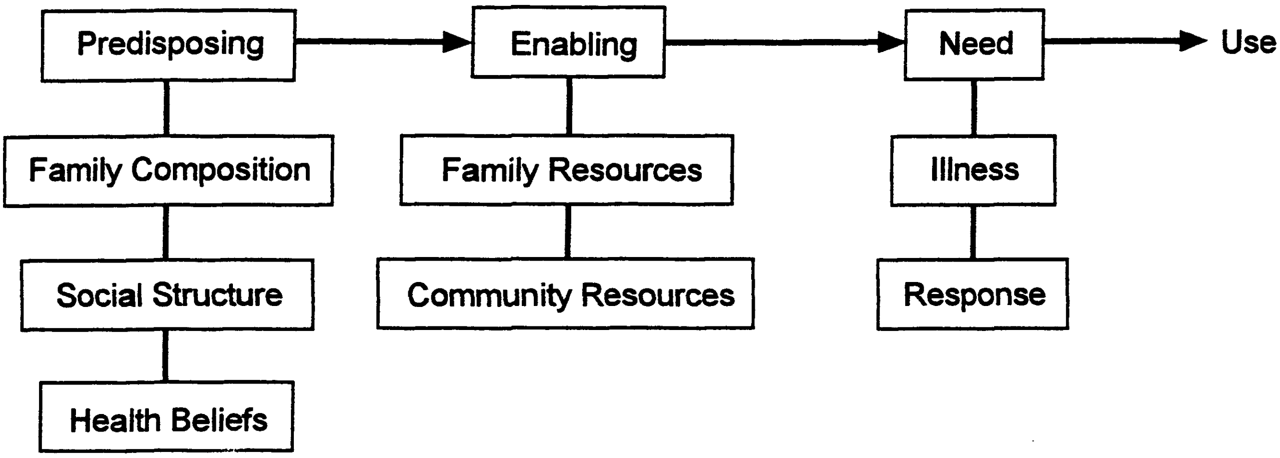
Table 6.10: Odds ratios for GP contact by self-perceived health and ADL dependency, women aged 75-81 years and 82-88 years, surveyed in 1988

Age	75-81		82-88	
	Crude Odds Ratio[2]	Odds Ratio from Full Model[1]	Crude Odds Ratio	Odds Ratio from Full Model[1]
Self-Perceived Health				
Good	1.0	1.0	1.0	1.0
Fair	1.7 (1.2, 2.5)*	1.7 (1.2, 2.6)*	1.5 (0.8, 2.8)	1.4 (0.7, 2.7)
Poor	2.1 (1.1, 4.0)*	2.2 (1.1, 4.2)*	3.3 (1.5, 7.0)*	2.5 (1.1, 5.7)*
ADL Dependency				
Independent	1.0	1.0	1.0	1.0
Dependent	0.9 (0.5, 1.6)	0.8 (0.4, 1.4)	2.0 (1.1, 3.4)*	2.0 (1.1, 3.6)*
Living Arrangements				
Married	1.0	1.0	1.0	1.0
Not married, with others	0.5 (0.3, 1.0)	0.6 (0.3, 1.0)	0.5 (0.2, 1.5)	0.4 (0.1, 1.3)
Alone	0.9 (0.5, 1.3)	0.9 (0.6, 1.4)	1.0 (0.4, 2.2)	1.0 (0.4, 2.3)
Difficulty Managing on Present Income				
No difficulty	1.0	1.0	1.0	1.0
Difficulty	0.8 (0.4, 1.2)	0.7, (0.4, 1.2)	1.3 (0.6, 2.5)	1.1, (0.5, 2.3)
Incontinence				
Not incontinent	1.0	1.0	1.0	1.0
Incontinent of urine and faeces	1.5 (0.9, 2.6)	1.5 (0.8, 2.7)	1.7 (0.9, 3.3)	1.3 (0.6, 2.7)

[1] Full model includes main effects for social class, difficulty managing on income and living arrangements, self-perceived health, ADL dependency, visual and hearing impairment and incontinence

[2] Asterisk indicates 95% confidence interval for odds ratio does not include unity

Figure 6.1: Behavioural model of use of health services



Reproduced from Wolinsky, F.D. (1990) Health and Health Behavior Among Elderly Americans. Springer: New York pp.78

Figure 6.2: Percentage of men reporting GP contact by survey

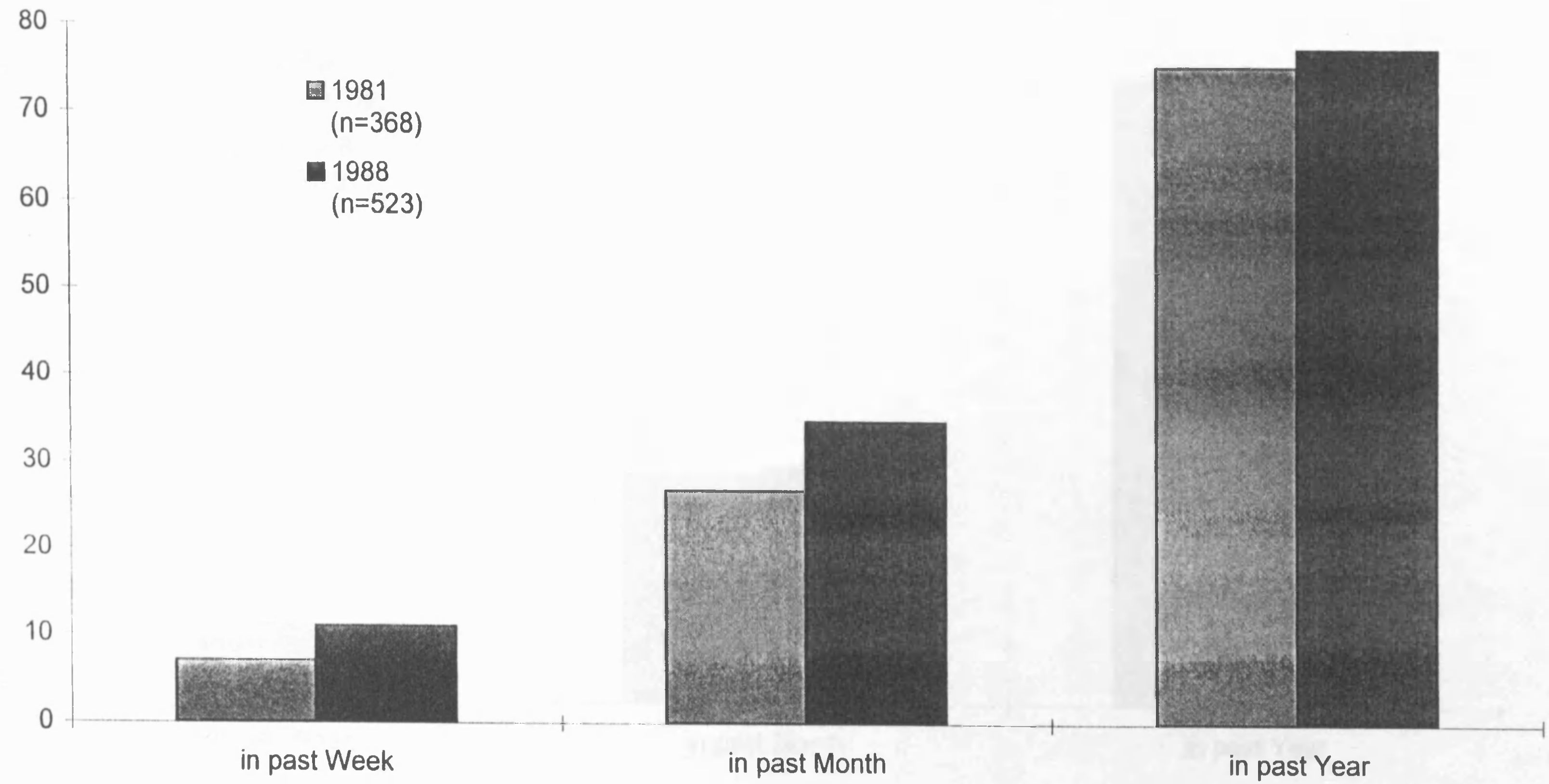
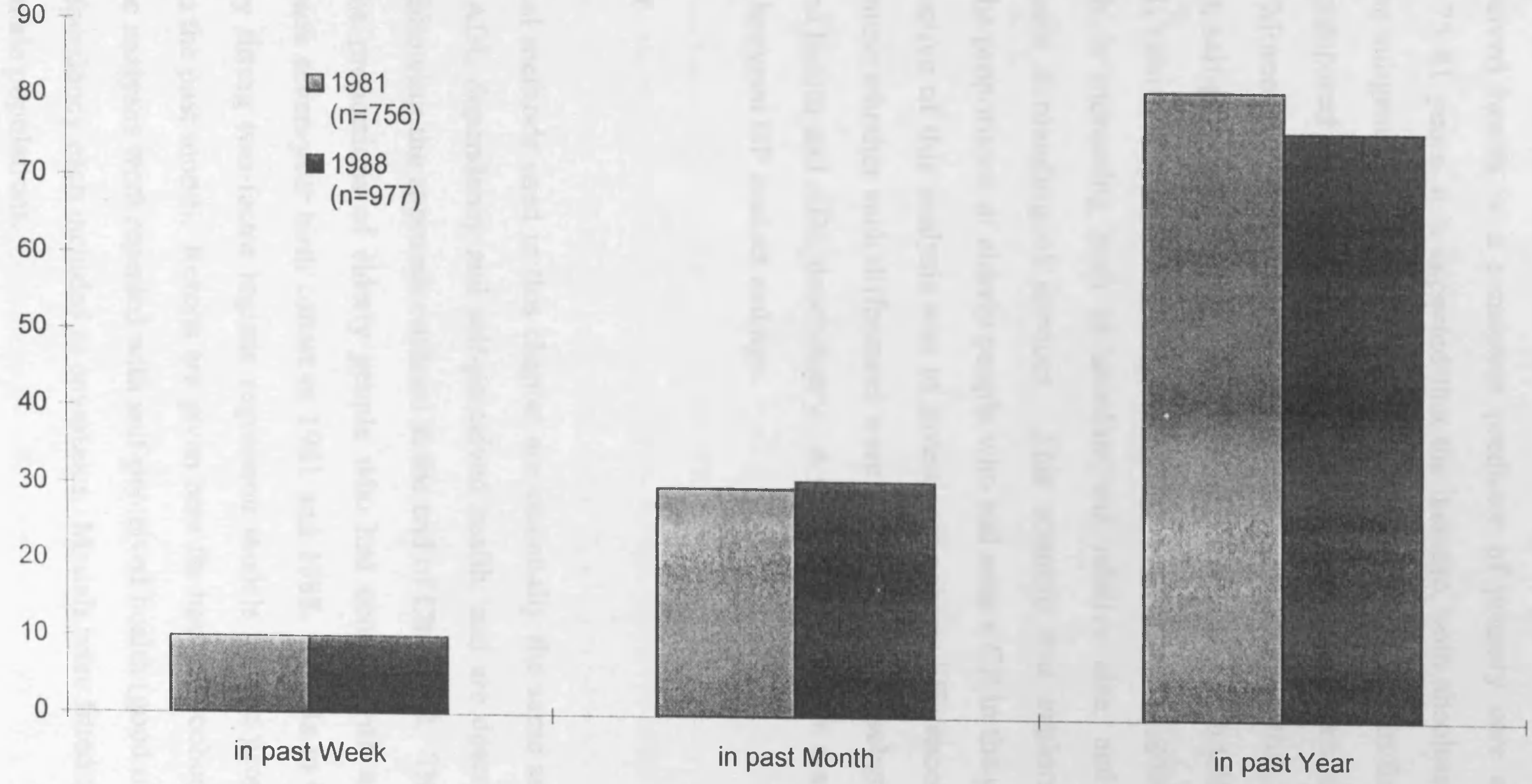


Figure 6.3: Percentage of women reporting GP contact by survey



7. TRENDS IN GP CONTACT

As self-perceived health is a consistent predictor of primary care contact amongst people aged 75-81 years, it is expected that the increase, both absolute and relative, in the size of the subgroup with less than good self-perceived health in the cohort born in 1906-1912, compared to preceding cohorts, will be reflected by increased GP contact in this cohort. Moreover, results reported in the last chapter suggest that, at least for men in this cohort, self-perceived health is more strongly associated with GP contact in 1988 than in 1981, raising the possibility of a subgroup with less than good self-perceived health which is increasing both in absolute and relative size, and simultaneously becoming more demanding of services. This scenario was explored using cohort analysis of the proportions of elderly people who had seen a GP in the past month. The primary objective of this analysis was to investigate cohort differences in GP contact, and to determine whether such differences were consistent across subgroups defined by self-perceived health and ADL dependency. A secondary objective was to examine the relationship between GP contact and age.

7.1 Methods

The statistical methods used in this chapter are essentially the same as in the previous analysis of ADL dependency and self-perceived health, and are described in detail in Chapter 4, following the approach outlined at the end of Chapter 2. The initial analysis compared the proportions of elderly people who had contact with a GP in the past month for each seven-year birth cohort in 1981 and 1988. Trends in GP contact were examined by fitting two-factor logistic regression models for the proportion who had seen a GP in the past month. Results are given here for both age-cohort and age-period models. The analyses were repeated with self-perceived health (good or less than good) and ADL dependency each included as covariates. Models were fitted separately for the female and male populations.

7.2 Women: trends in rates of contact with a GP

Amongst the female population, no consistent pattern of cohort or period differences was found. From diagonal comparisons in Table 7.1., it can be seen that the proportion seeing a GP in the past month was the same at both surveys for 75-81 year olds, somewhat greater in 1988 for 82-88 years year olds, and less in 1988 for 89-95 year olds, although here the numbers are small. The age-profile may be U-shaped, with a slight dip in rates of contact at age 82-88 years (Figure 7.1). Although rates of contact amongst women aged 82-88 in 1988 were somewhat higher compared to women of similar age in 1981, this difference is within the margins allowed for sampling error. Lack of evidence of systematic differences in rates of contact is reflected in the modelling (Table 7.2), with no statistically significant departure from a null model, with a predicted proportion of approximately 30% seen in the past month across each age group and cohort.

As concluded in Chapter 6, self-perceived health is associated strongly with GP contact across the cohorts, with the exception of women aged 89-95 years in 1981 (Table 7.3). As self-perceived health is an enduring indicator of GP contact, the cohort analysis was repeated with self-perceived health included as a covariate. If trends in GP contact and levels of self-perceived health are unrelated, the finding of no trend in GP contact should be repeated in subpopulations by good and less than good self-perceived health. This is indeed the case for women aged up to 88 years (Figure 7.2). In the eldest group, prevalence of contact in the past month by self-perceived health is unstable across cohorts, reflecting weakening in the predictive value of self-perceived health for GP contact already noted in Chapter 6, as well as smaller numbers. Absence of period or cohort differences was confirmed by statistical modelling (Table 7.4). Statistical significance of the relatively high level of contact amongst 89-95 year olds with good self-perceived health in 1981 was investigated by including an interaction term in the model, to allow for greater cohort differences amongst women with good self-perceived health, but the resulting improvement in fit of the model was non-significant (change in G^2=7.2, df=3, p=0.07). With this possible exception, the overall picture with regard to rates of contact amongst women is again one of little or no systematic difference between cohorts. Subdivision by self-perceived health does produce a more consistent pattern of decline in the rate of contact with age within cohorts, but the magnitude of the decline remains statistically non-significant.

Of women who were independent in ADL, 29% had seen a GP in the past month, compared with 34% of women who were dependent. This quite small difference in the risk of contact between women dependent and independent in ADL is maintained across the age groups and cohorts, but otherwise no consistent pattern emerges (Figure 7.3). In the light of the analysis of predictors of GP contact, it was expected that differences in the risk of GP contact related to ADL dependency would be confounded with differences related to self-perceived health. For this reason, models including ADL dependency as a covariate were fitted to predict the observed logodds of GP contact in a four-way crosstabulation by age, cohort, self-perceived health and ADL dependency. However, differences in the risk of contact with a GP between women independent and dependent in ADL are negligible once self-perceived health is taken into account. Extra contact in the dependent group could be accounted for by the fact of being dependent, or equally by high levels of less than good self-perceived health amongst the dependent women. Although self-perceived health and ADL dependency are confounded, subdivision of the population by ADL dependency makes no material difference to the estimates for age, period and cohort differences, at least up to age 89 years, so the conclusion of stable rates of contact for women across the cohorts seems robust (Table 7.5).

7.3 Women: rates of contact with a GP by age

In the absence of cohort or period differences, female populations from the two surveys were aggregated and the relationship between GP contact and age investigated in a more fine-grained analysis. Plots of the proportion of women who had seen their GP, by age are given in Figures 7.4 and 7.5 respectively for women independent and dependent in ADL. Women aged over 90 are omitted from the figures because of small numbers. Amongst women who are independent in ADL there is a clear and statistically significant trend, with the risk of being seen decreasing when women in their late eighties are compared to those in their seventies. This trend is obscured in the age-cohort analysis because of the coarseness of seven-year birth-cohorts. The gradient with age is maintained at least until age 85 years, with the proportion seen declining from more than 35% at age 75 years to less than 25% by age 85 years. By contrast, for women dependent in ADL, there is little evidence of trend, with quite high rates of contact across the age groups, from 75 years through 95 years. A similar, but less distinct pattern was observed when the plots were repeated for women in good and less than good self-perceived health. One possible interpretation for this distinction is that decline in rates of contact amongst older people who are independent in ADL represents, patients disengaging from contact with their GP, whilst ADL dependency marks a point at which disenabling factors come into play, and the decision to seek contact may be passed to a carer. This process may also be reflected in the relatively high rate of contact amongst the oldest women aged over 90 years. Of the 57 women aged over 90 years interviewed at the two surveys, 22 (39%) had seen a GP in the past month.

Predicted prevalence of contact by age and self-perceived health for women independent in ADL, together with 95% confidence interval boundaries, are given in Figure 7.6. Amongst women dependent in ADL, GP contact was unrelated to age, and the final model had separate rates of contact by self-perceived health. For women dependent in ADL but in good self-perceived health, the proportion seen was 24% (95% CI 16.9% to 33.1%), compared to 40% (33.1% to 46.3%) for women who were dependent and considered their health to be fair or poor.

7.4 Men: rates of contact with a GP by age, cohort and survey

There were rather different patterns of contact by age and cohort for the male population (Table 7.1). Whereas, amongst the female population there was no evidence of cohort differences up to age 90, for the men, there were graduated cohort differences of some magnitude, with more recent cohorts having more contact (Figure 7.7). Odds ratios from age-cohort and age-period models for GP contact are given in Table 7.6. Odds of contact were significantly reduced for the 1892-1898 cohort, compared with the most recent cohort. There was also some evidence of a longitudinal ageing effect within cohorts, although this finding was based largely on the experience of the 1899-1905 cohort, and did not quite reach statistical significance. The proportion seen by a GP in the past month may alternatively be modelled by a period effect, with increased GP contact in 1988, compared to 1981, this difference being statistically significant. The number of men interviewed at home aged 89-95 years was small, and these men are omitted from the subgroup analyses.

7.5 Men: rates of contact with a GP by self-perceived health

To investigate the hypothesis that the cohort difference in GP contact is attributable to the increased proportion of men with less than good self-perceived health in the newer cohorts, the proportion of men seen in the past month was plotted by age and cohort separately for men in good and less than good self-perceived health in Figure 7.8, and also given in Table 7.7. The age-cohort profiles by self-perceived health were quite different, and suggested that the cohort differences in the rates of GP contact were attributable almost entirely to differences in rates of contact for men in less than good self-perceived health. When comparisons were confined to men who said their health was good, there was little or no change in the odds of being seen between cohorts or age groups. Consistently 20-25% of the population with good self-perceived health was seen, with only a slight increase in contact with age. By contrast, when comparisons were drawn amongst men with less than good self-perceived health, there were large intercohort differences, with the men with less than good self-perceived health in the newer cohorts having greater risk of being seen.

Existence of an intercohort difference confined to the subpopulation in less than good self-perceived health was supported by statistical modelling (Table 7.8). Although a model with additive effects of age, cohort and self-perceived health was a good fit for the data, the distinction between large cohort differences for men in less than good self-perceived health, compared to little or no cohort differences in men with good self-perceived health, was reflected by a statistically significant interaction between cohort and self-perceived health (change in G^2 =8.55, df=3, p=0.04). For the subgroup with less than good self-perceived health, the odds of being seen were significantly reduced for both 1892-1898 and 1899-1905 cohorts, compared to the cohort born in 1906-1912. There was an increase in the proportion of men having contact with a GP as the cohorts aged, but this intracohort difference was not statistically significant. Similarly, in the age-period framework, including an interaction term which allows for larger period differences in the subgroup with less than good self-perceived health produced a significant improvement in fit (change in G^2=3.83, df=1, p=0.05). In terms of period differences, odds of GP contact were almost doubled between 1981 and 1988 for men in fair or poor self-perceived health, but unchanged in those whose self-perceived health was good.

Models including ADL dependency as a covariate were fitted for the logodds of GP contact for men in a crosstabulation by age, cohort, self-perceived health, and ADL dependency (Table 7.9). In the age-cohort framework there was a significant difference in the proportion having contact with a GP in the dependent and independent groups (change in G^2=8.5, df=1, p=0.004). However, this difference was no longer evident when ADL dependency is included in addition to self-perceived health (change in G^2=1.8, df=1, p=0.18). As with women, the difference in rates of GP contact by ADL dependency was confounded with the larger difference in rates by self-perceived health and inclusion of ADL dependency did not materially effect conclusions regarding period and cohort differences in rates of GP contact.

7.6 Men: rates of contact with GP by age

Evidence for a systematic relationship between GP contact and age amongst men is equivocal, in the presence of quite large cohort differences together with sample sizes at the advanced ages that are smaller than for the women. In the seven-year birth cohort analysis, the best-fitting models predict a statistically non-significant increase in GP contact with increasing age. Tabulation of rates by age for men in good self-perceived health, where cohort differences are minor, tentatively supports a positive gradient with age, although this is largely due to the influence of abnormally high rates of contact amongst men aged 82 years (Table 7.9).

7.7 Discussion and conclusions

There are qualitative differences in the conclusions relating to rates of contact with a GP for men and women. For the female population, little evidence was found of any cohort or period effect, at least amongst women in the cohorts born from 1892 through 1912. In these cohorts, the proportion of elderly women seen by a GP remained steady at around 30% between 1981 and 1988. Lack of cohort differences is consistent with the time series for contact with a GP from national data (General Household Survey, 1993). Although the timeframe for reported contact with a GP in the GHS is two weeks before interview, rather than a month, this would be unlikely to affect the direction of trends. The conclusion for women was that increased levels of less than good self-perceived health amongst the newer cohorts are not accompanied by more frequent contact with a GP. An exception to this is the relatively high rate of contact in Melton amongst women aged 89-95 years in 1981, but the standard error of this estimate is large, due to small numbers at these advanced ages. This high rate of contact would, however, be consistent with more routine surveillance of the old-old by the Melton GPs in 1981 than in 1988.

Analysis of the relationship between GP contact and birth year reinforces the impression that rates of GP contact at age 90 years and over follow a different pattern from that observed at ages 75-89 years, although this issue will remain open until larger numbers of people in their nineties are surveyed. The steady decrease in the proportion of women independent in ADL who had contact with a GP in the past month through the agespan 75-89 years is not reflected elsewhere in the UK literature. Bowling, Farquahar and Browne (1991) report from a cross-sectional analysis of populations aged over 65 years in London and Essex, that use of health services increased with age with the exception of contact with opticians and dentists.

Two particular features of the methodology may account for the different conclusions. Firstly, many studies report trends in contact with a GP in the past year. As already argued, contact in the past year may be interpreted more straightforwardly as a contact measure, compared to contact in the past month which may be viewed as closer, although still imperfect, proxy for volume. Contact in the past year may be less sensitive than contact in the past month either to a tendency for women to trouble their GP more infrequently as they age into their eighties, or to the selection out of the cohort of more frail individuals by mortality. Moreover, amongst people aged 75 years and over, the proportion with contact in the past year is typically at least 75%, and numbers with no contact are conversely small, which may have a bearing upon the failure of studies (for example, Wolinsky, Mosely and Coe, 1986) to find an interaction between age and sex as predictors of physician contact. Secondly, few studies report trends in contact disaggregated by gender. For example, in the Royal College of General Practitioners Morbidity Survey, there was an increase of 15% in the proportion of the population aged 75 years and over consulting in the survey year from 1981/2 to 1991/2, but this increase is not disaggregated by gender.

The relationship between age and physician contact has also been explored by Wolinsky (1990), who reports results from the US Health Interview Survey for 1972, 1976 ,1980 and 1984, without distinguishing male and female populations. The percentage of elderly people with at least one contact with a physician in the past year increased as the cohorts aged until age 80 years, when the proportion stabilised. However, in the case of volume of contacts in the year, there was a J-shaped relationship, with the average number of contacts peaking at around age 80 years and then falling back somewhat at ages beyond 80 years. Wolinsky speculates that this pattern may be explained if people in their eighties view their health problems as part of the normal process of ageing, and hence are less likely to consult a doctor about them. It is possible that the decline in physician contact from age 75 years onwards in Melton has a similar explanation, with an earlier onset of self-defined old age in the UK than in the US.

For men, analysis of rates of contact by birth year is complicated by the presence of non-negligible cohort differences, and firm conclusions about the relationship between rates of contact and age cannot be drawn. However, absence of any indication of declining rates of contact in men suggests that this effect may be confined to the female population. It could be that factors associated with disengagement, such as use of telephone contact or substitution of informal services, operate more strongly in the female population. Alternatively, effects of disengagement in the male population may be masked by the intercohort differences.

Differences in rates of contact in the male population between cohorts at comparable ages were quite large, with the newer cohorts having greater risk of contact with a GP than their precursors at the same age. Whilst in the earlier cohorts, men had lower rates of contact with a GP than women, in the 1906-1912 cohort this was reversed, with 34% of men having seen a GP in the past month, compared to 31% of the women. Closing of the gender gap is consistent with the GHS time series, where the effect has continued into the 1990s (Figure 7.10) and has also been reported in US surveys (Wolinsky, 1990; Verbrugge, 1985).

When the male subpopulation was subdivided, the cohort difference in GP contact was evident only amongst the subgroups with less than good self-perceived health. This could reflect a change in the casemix amongst this group. This scenario may be consistent with increased incidence of health problems due to survival and advances in technology as discussed in Chapter 5. Alternatively, there may change in the willingness of the elderly men to consult a doctor with their health problems, perhaps driven by cultural effects indexed by birth cohort, or perhaps by period differences relating to health promotion. A third scenario is that increased rates of contact are due to changes in the management of these health problems in the General Practice over the survey period. There is anecdotal evidence to suggest that some common conditions such as diabetes and hypertension were more likely to be managed in the Practice in 1988, where they would have been referred to secondary care in 1981. Aside from national trends, the Practice moved to a purpose-built health centre with much improved facilities in 1982, and this will have affected the range of care on offer.

Improved facilities in Melton Mowbray, in tune with a national shift towards management of a broader range of conditions in primary as opposed to secondary care, may have lead to increased rates of contact amongst elderly men. However, it seems unlikely that period effects related to changes specific to Melton Mowbray can account wholly for the intercohort difference in GP contact, firstly, as it is not clear why the benefits of enhanced facilities should be entirely confined to men, and secondly as change in practice facilities cannot reasonably explain the higher rates of less than good self-perceived health in the 1906-1912 cohort. Possible explanations for the increase in the proportion of elderly men with recent GP contact between 1981 and 1988, together with policy and resource implications, will be considered further in Chapter 8.

7.8 Summary

Two-factor logistic regression models were fitted to investigate age, cohort and period differences in contact with a GP in the past month. There were no cohort or period differences for women, although the proportion having seen a GP in the past month declined significantly with increasing age from more than 35% at age 75 years to less than 25% by age 85 years. Whilst age-specific rates of contact for the women were unchanged between 1981 and 1988, in men, substantial cohort differences were found. Each succeeding cohort had higher rates of GP contact, compared to the previous cohort surveyed at comparable ages, these cohort differences in GP contact being apparent only in comparisons between subgroups of men with less than good self-perceived health, when the population was subdivided. For men in good self-perceived health, rates of contact with a GP were comparable across cohorts. When comparisons were confined to subgroups with less than good self-perceived health, the ratio of odds of contact with a GP was estimated at 0.54 (95% CI 0.34 to 0.87) for the cohort born in 1899-1905 and aged 75-81 years in 1981, and 0.20 (0.07,0.59) for the 1892-1898 cohort, both compared to the 1906-1912 cohort

The trend in self-perceived health was accompanied by increased GP contact in men, but not in women. It seems that either the nature of the ill-health being recorded by the self-perceived health question, or the response of patients and their GPs to this ill-health, differed systematically between male and female populations.

Table 7.1: Proportion (%) of men and women seen by a GP in past month by age (midpoint of age group), cohort (defined by birth year) and year of survey

	Women				Men			
Cohort (age at 31/12/1980)	**1981**		**1988**		**1981**		**1988**	
	%	**(base)**	**%**	**(base)**	**%**	**(base)**	**%**	**(base)**
1906-1912 (68-74 yrs)	-	-	31	(623)	-	-	34	(378)
1899-1905 (75-81 yrs)	31	(519)	29	(294)	28	(287)	37	(134)
1892-1898 (82-88 yrs)	24	(186)	26	(50)	25	(69)	36	(11)
1885-1891 (89-95 yrs)	33	(49)	60	(5)	17	(12)	-	-

Table 7.2: Estimated odds ratios of contact in the past month, under age-period and cohort models for women, with 95% confidence intervals (CI) in parentheses

Framework	Model	Covariates	OR (95% CI)
Age-Cohort	Cohort + Age	1906-1912	1.00
	X^2=0.3, df=1	1899-1905	0.97 (0.76, 1.25)
		1892-1898	0.76 (0.46, 1.24)
		1885-1891	1.21 (0.51, 2.83)
		Age	1.00
			0.99 (0.95, 1.04)
Age-Period	Age + Period	1981	1.00
	X^2=3.1, df=3	1988	1.05 (0.85, 1.30)
		Age	0.98 (0.95, 1.01)

Table 7.3: Proportion (%) of women seen in past month by age (midpoint of age group), cohort (defined by birth year), self-perceived health and year of survey

	Self-perceived health							
	Good				Less than Good			
	1981		1988		1981		1988	
Cohort (age at 31/12/1980)	%	(base)	%	(base)	%	(base)	%	(base)
1906-1912 (68-74 yrs)	-	-	25	(306)	-	-	37	(314)
1899-1905 (75-81 yrs)	26	(297)	22	(145)	38	(221)	35	(146)
1892-1898 (82-88 yrs)	17	(109)	11	(27)	33	(76)	43	(23)
1885-1891 (89-95 yrs)	39	(33)	25	(4)	20	(15)	67	(6)

Table 7.4: Estimated odds ratios of contact with a GP in the past month, under age-cohort and age-period models with self-perceived health included as a covariate for women, with 95% confidence intervals (CI) in parentheses

Framework	Model	Covariates	OR (95% CI)
Age-Cohort	Additive	1906-1912	1.00
	Age, Cohort.	1899-1905	1.02 (0.79, 1.31)
	Self-perceived health	1892-1898	0.85 (0.52, 1.41)
	(X^2=9.0, df=6)	1885-1891	1.59 (0.67, 3.78)
		Good Self-perceived health	1.00
		Poor/Fair Self-perceived health	1.82 (1.47, 2.26)
		Age	0.98 (0.94, 1.03)
Age-Period	Age, Period, Self-perceived health	1981	1.00
		1988	0.99 (0.80, 1.23)
	(X^2=13.0, df=8)	Independent	1.00
		Dependent	1.81 (1.47, 2.24)
		Age	0.98 (0.95, 1.01)

Table 7.5: Estimated odds ratios of contact with a GP in the past month, under age-cohort and age-period models with ADL dependency included as a covariate for women, with 95% confidence intervals (CI) in parentheses

Framework	Model	Covariates	OR (95% CI)
Age-Cohort	Age, Cohort, ADL Dependency (X^2=5.0, df=6)	1906-1912	1.00
		1899-1905	0.64 (0.31, 1.31)
		1892-1898	0.84 (0.38, 1.83)
		Independent	1.00
		Dependent	1.32 (1.02, 1.72)*
		Age	0.99 (0.94, 1.03)
Age-Period	Age+Self-Perceived Health (X^2=7.6, df=8)	1981	1.00
		1988	1.07 (0.86, 1.32)
		Independent in ADL	1.00
		Dependent in ADL	1.33 (1.02, 1.72)
		Age	0.98 (0.95, 1.01)

Table 7.6: Estimated odds ratios of contact in the past month, under age-period and cohort models for men, with 95% confidence intervals (CI) in parentheses

Framework	Model	Covariates	OR[a] (95% CI)
Age-Cohort	Cohort + Age	1906-1912	1.00
	(X^2=0.05, df=1)	1899-1905	0.74 (0.53, 1.04)
		1892-1898	0.43 (0.20, 0.89)
		Age	1.06 (0.99, 1.13)
Age-Period	Age + Period	1981	1.00
	(X^2=1.2, df=3)	1988	1.45 (1.08, 1.95)
		Age	1.00 (0.95, 1.04)

Table 7.7: Proportion (%) of men seen in past month by age (midpoint of age group), cohort (defined by birth year), self-perceived health and year of survey

	Self-perceived health							
	Good				Less than Good			
	1981		1988		1981		1988	
Cohort (age at 31/12/1980)	%	(base)	%	(base)	%	(base)	%	(base)
1906-1912 (68-74 yrs)	-	-	21	(211)	-	-	51	(164)
1899-1905 (75-81 yrs)	23	(178)	30	(76)	36	(109)	45	(56)
1892-1898 (82-88 yrs)	26	(43)	29	(7)	23	(26)	50	(4)
1885-1891 (89-95 yrs)	10	(10)	-	-	50	(2)	-	-

Table 7.8: Estimated odds ratios of contact in the past month, adjusting for self-perceived health under age-period and cohort models for men, with 95% confidence intervals (CI) in parentheses

Framework	Model	Covariates	Men OR[a] (95% CI)
	Age+Cohort +Self-perceived health (X^2=8.5, df=6)	1906-1912	1.00
		1899-1905	0.78 (0.55, 1.10)
		1892-1898	0.45 (0.21, 0.96)*
		Good Self-perceived health	1.00
		Poor/Fair Self-perceived health	2.42 (1.80, 3.26)*
		Age	1.05 (0.98, 1.13)
	Age, Cohort, Self- perceived health, with Cohort by Self-perceived health interaction	*Good Self-perceived health*	
		1906-1912	1.00
		1899-1905	1.10 (0.69, 1.75)
		1892-1898	0.88 (0.36, 2.11)
	(X^2=0.0, df=1)	*Less than good Self-perceived health*	
		1906-1912	1.00
		1899-1905	0.54 (0.34, 0.87)*
		1892-1898	0.20 (0.07, 0.59)*
		Age	1.05 (0.98, 1.13)
Age-Period	Age, Period, Self-perceived health, with Period by Self-perceived health interaction	*Good Self-perceived health*	
		1981	1.00
		1988	1.01 (0.66, 1.53)
	(X^2=4.6, df=3)	*Less than Good Self-perceived health*	
		1981	1.00
		1988	1.93 (1.23, 3.01)*
		Age	1.00 (0.95, 1.06)

Table 7.9: Estimated odds ratios of contact in the past month, adjusting for ADL dependency under age-period and cohort models for men, with 95% confidence intervals (CI) in parentheses

Framework	Model	Covariates	OR (95% CI)
Age-Cohort	Age, Cohort, ADL Dependency (X^2=4.2, df=3)	1906-1912	1.00
		1899-1905	0.74 (0.52, 1.04)
		1892-1898	0.44 (0.20, 0.91)
		Independent	1.00
		Dependent	1.60 (1.10, 2.33)*
		Age	1.05 (0.98, 1.12)
Age-Period	Age, Period, ADL Dependency (X^2=4.6, df=4)	1981	1.00
		1988	1.42 (1.05, 1.92)*
		Independent in ADL	1.00
		Dependent in ADL	1.61 (1.10, 2.34)*
		Age	0.99 (0.94, 1.05)

Table 7.10: Proportion (%) of men aged 75 years and over in good self-perceived health seen by a GP in the past month, by age

Age	75	76	77	78	79	80	81	82	83	84	85
Number interviewed	20	14	16	9	11	9	11	5	5	6	5
Percent seen by a GP in the past month	25	22	24	19	21	20	39	20	23	32	38

Figure 7.1: Percentage of women seen by a GP in the past month and number surveyed, by age (midpoint of age group) and cohort; community-based population

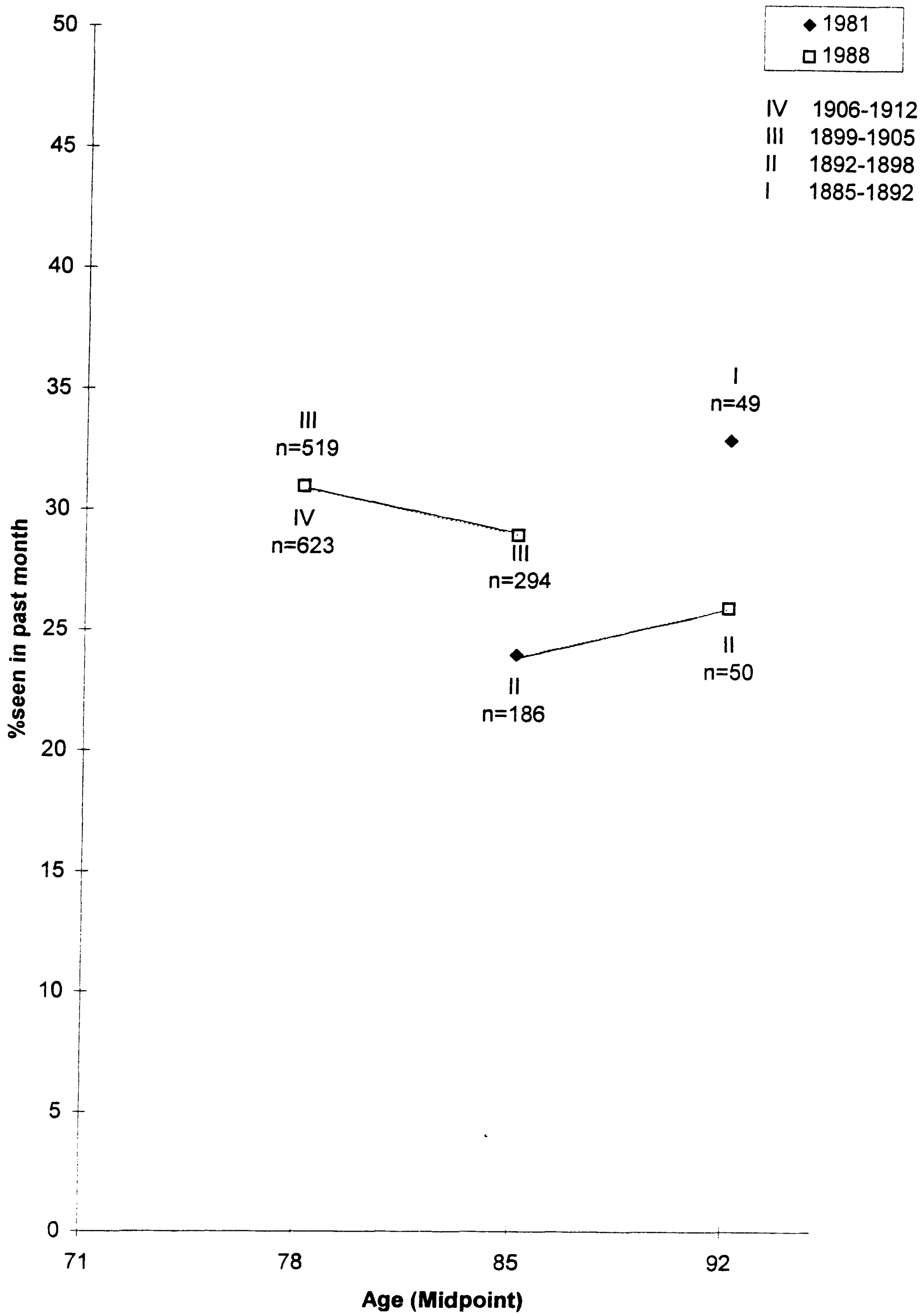


Figure 7.2: **Percentage of women seen by a GP in the past month and number surveyed, by age (midpoint of age group), cohort and self-perceived health; community-based population**

Women with good self-perceived health

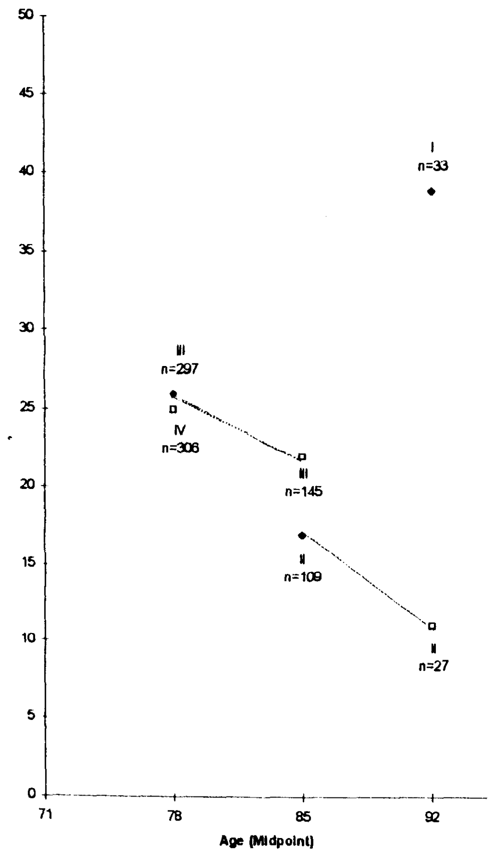


Figure 7.2 a

Women with fair or poor self-perceived health

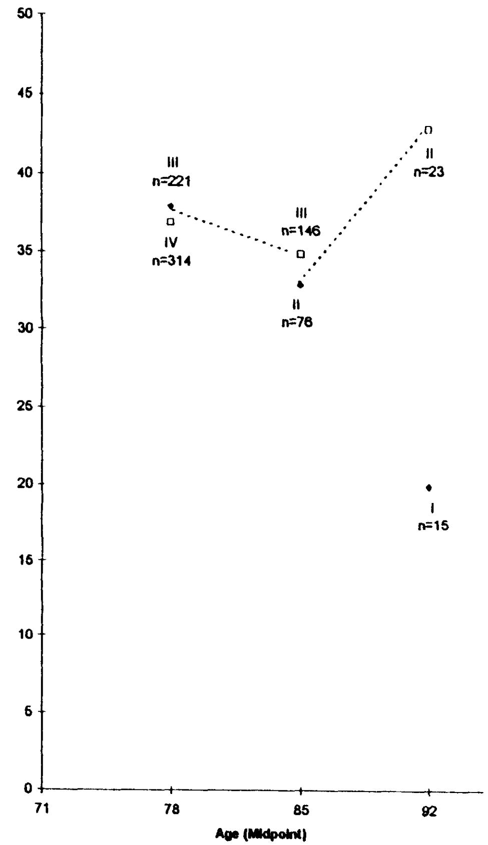


Figure 7.2b

Figure 7.3: **Percentage of women seen by a GP in the past month and number surveyed, by age (midpoint of age group), cohort and ADL dependency; community-based population**

Women independent in ADL

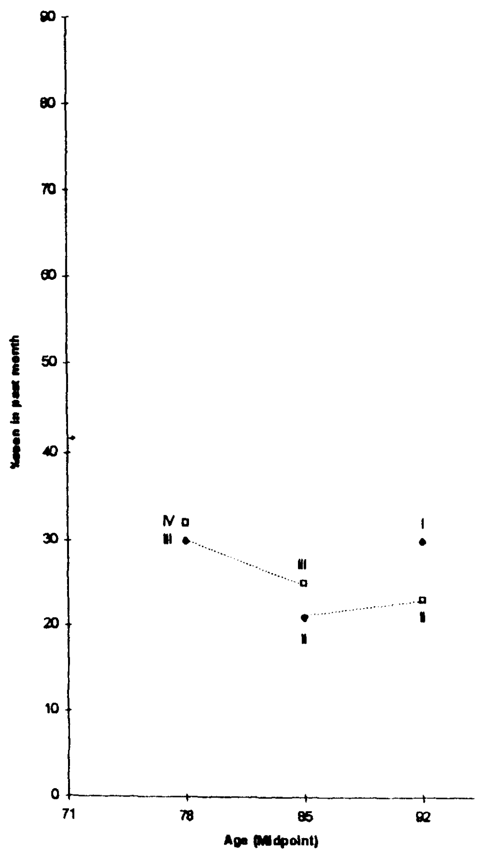


Figure 7.3a

Women dependent in ADL

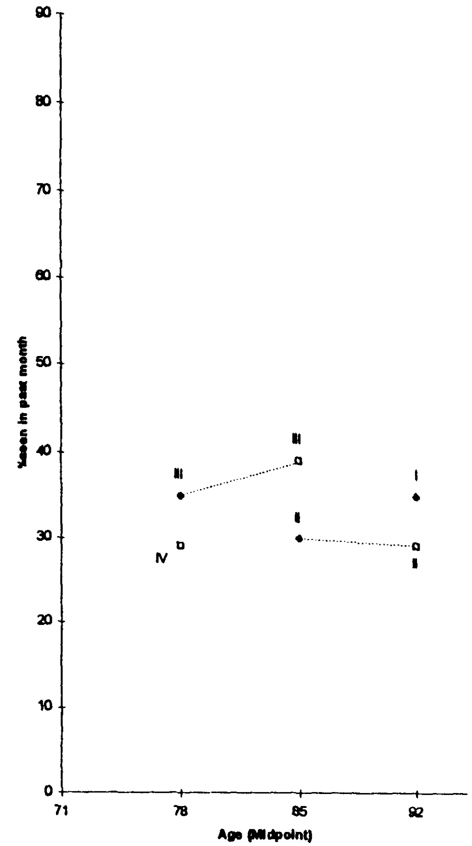


Figure 7.3b

Figure 7.4: Percentage seen by a GP in the past month by age; women interviewed at home and independent in ADL, 1981 and 1988

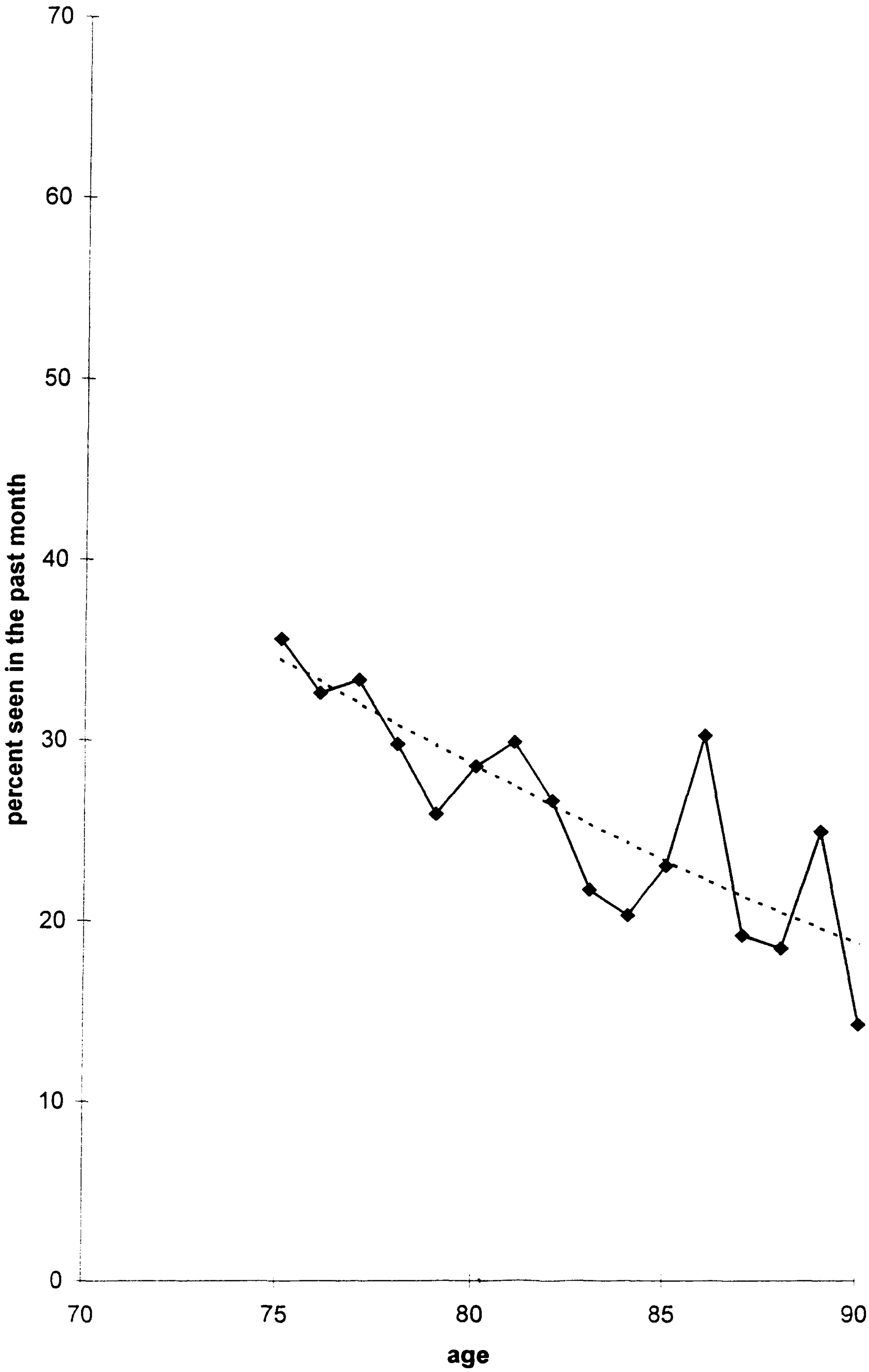


Figure 7.5: Percentage seen by a GP in the past month, by age; women dependent in ADL and interviewed at home, 1981 and 1988

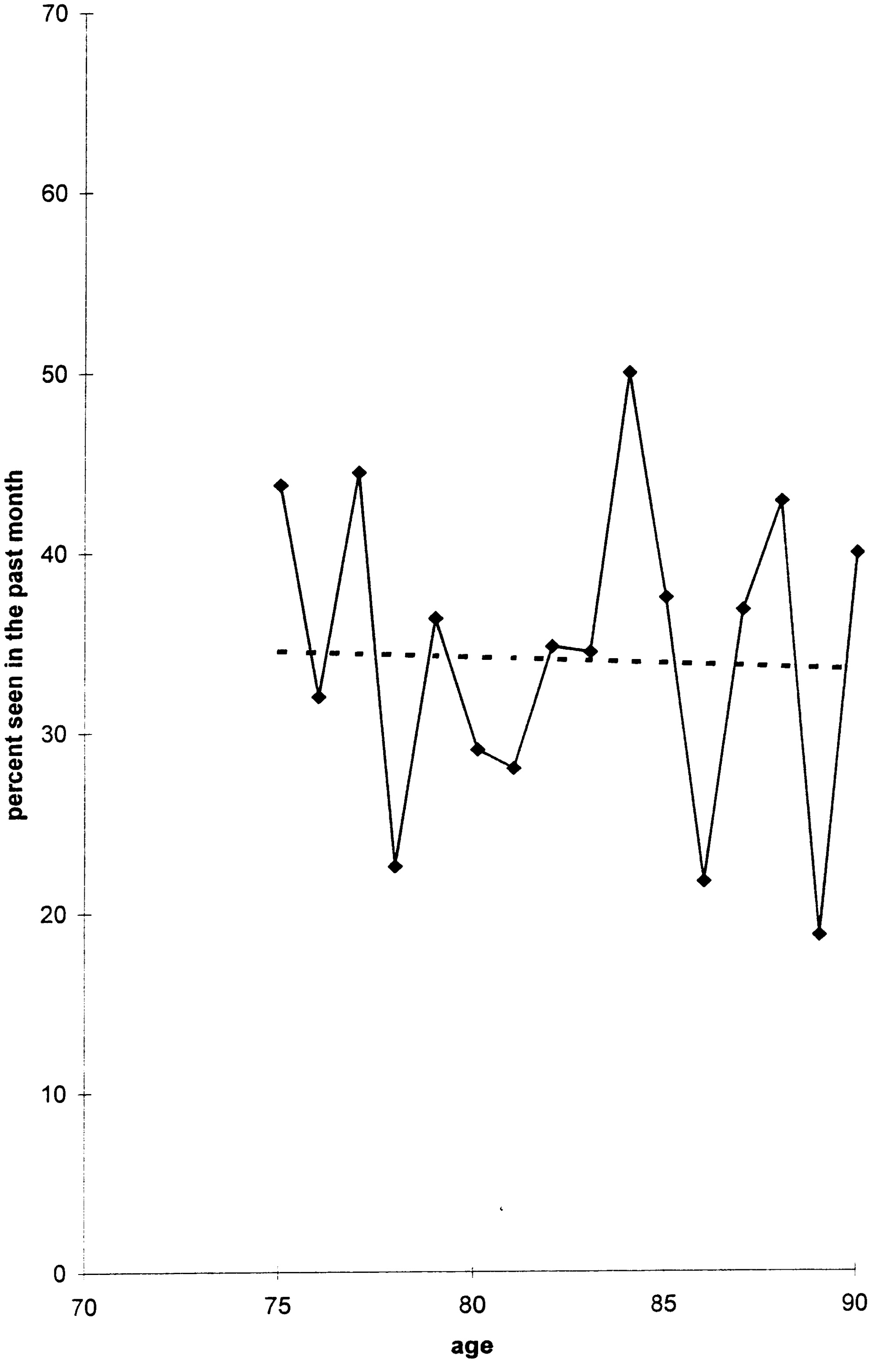


Figure 7.6: Estimated proportion seen by a GP in the past month, by age and self-perceived health: women independent in ADL

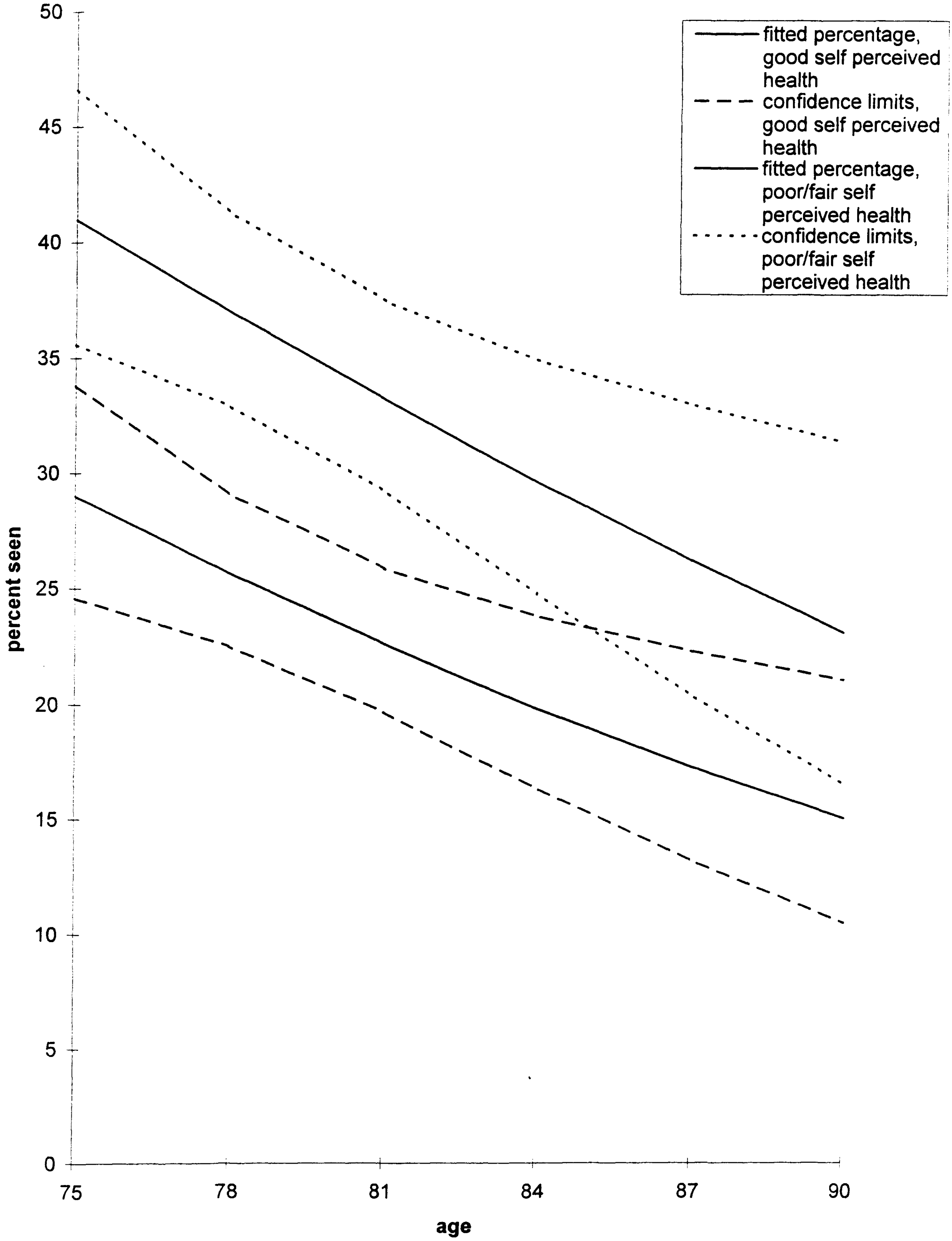


Figure 7.7: Percentage of men seen by a GP in the past month, by age (midpoint of age group) and cohort

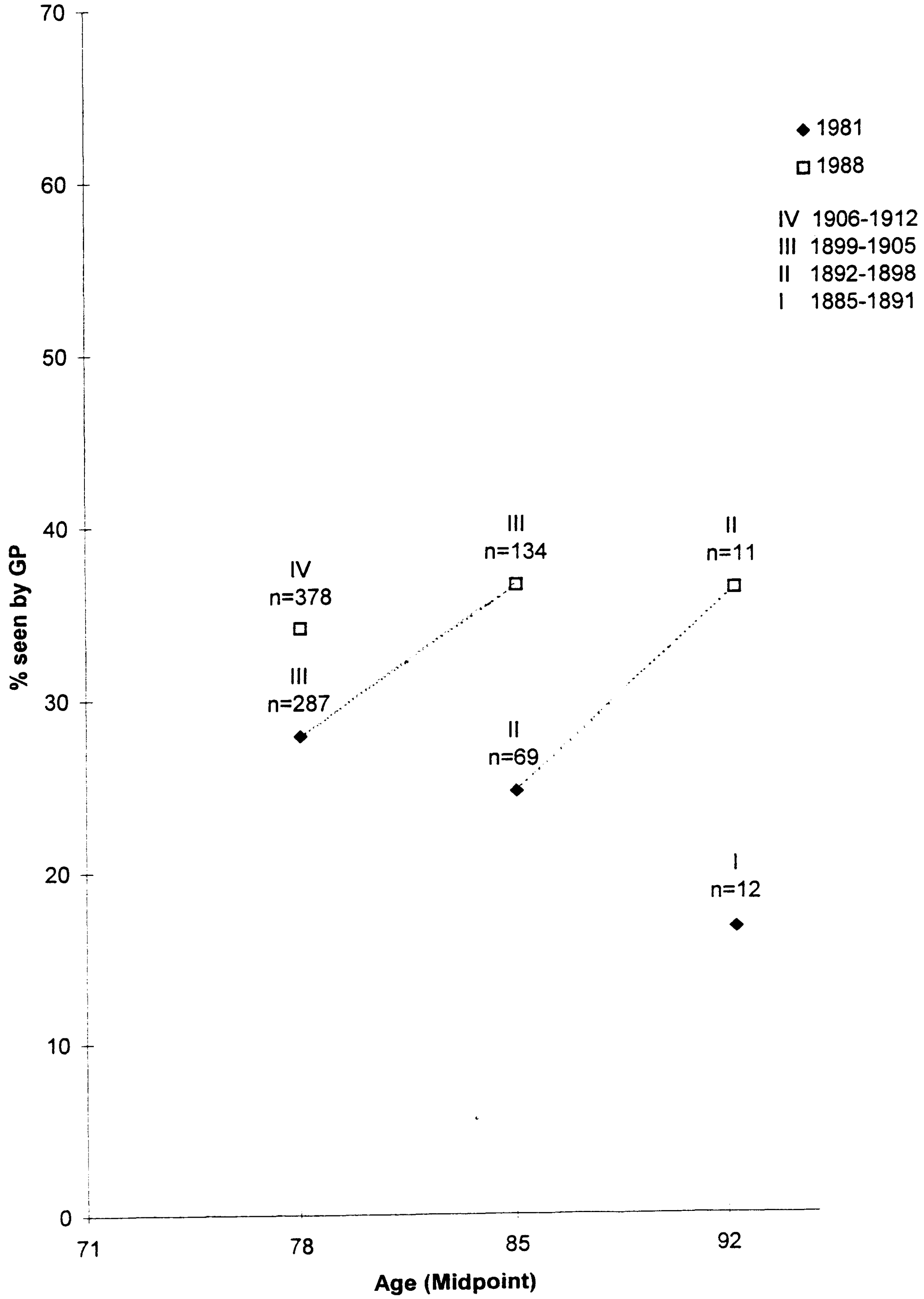


Figure 7.8: Percentage of men seen by a GP in the past month by age (midpoint of age group), cohort and self-perceived health

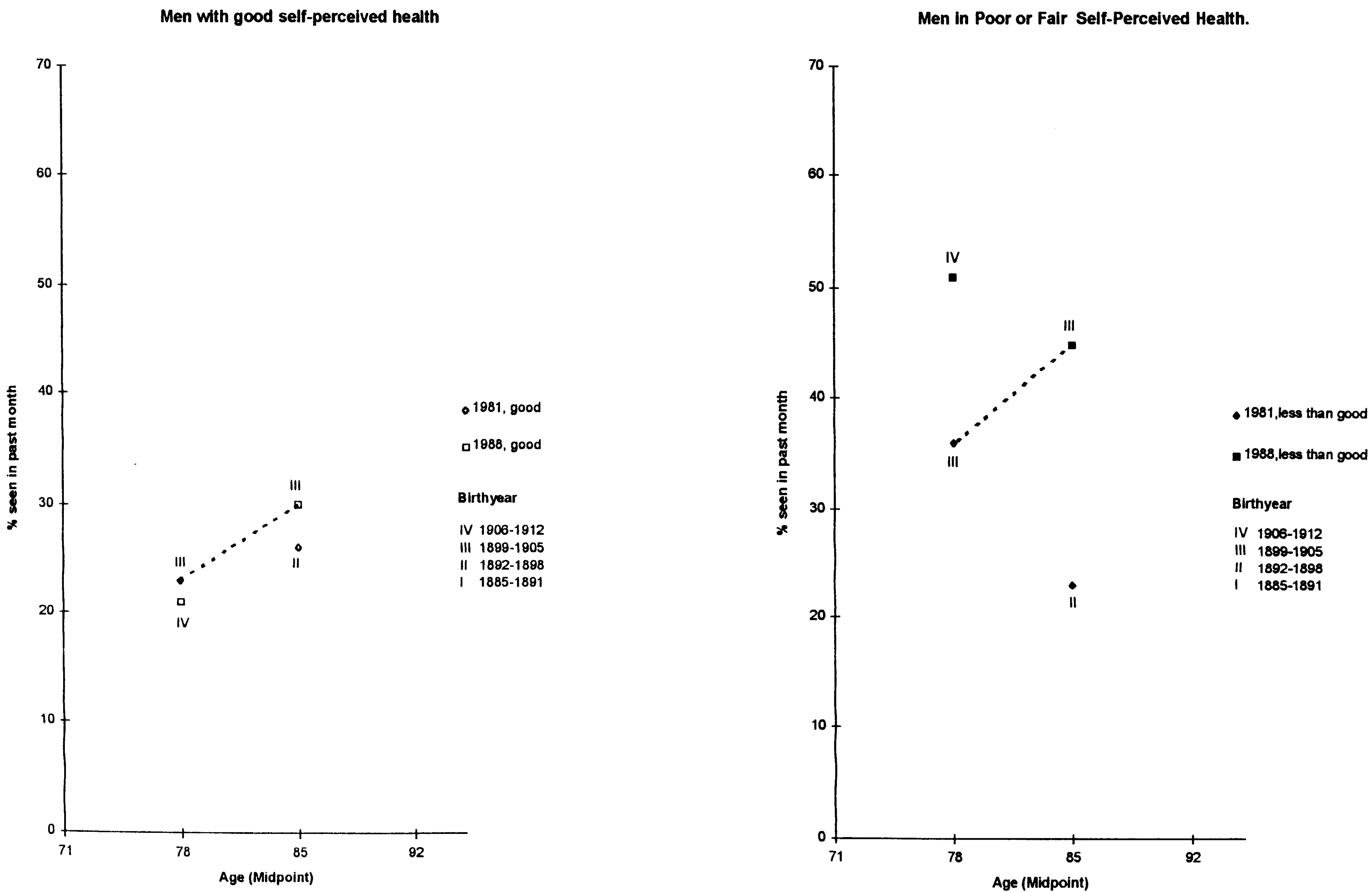


Figure 7.9: Percentage of women seen by a GP in the past year and number surveyed, by age (midpoint of age group) and cohort

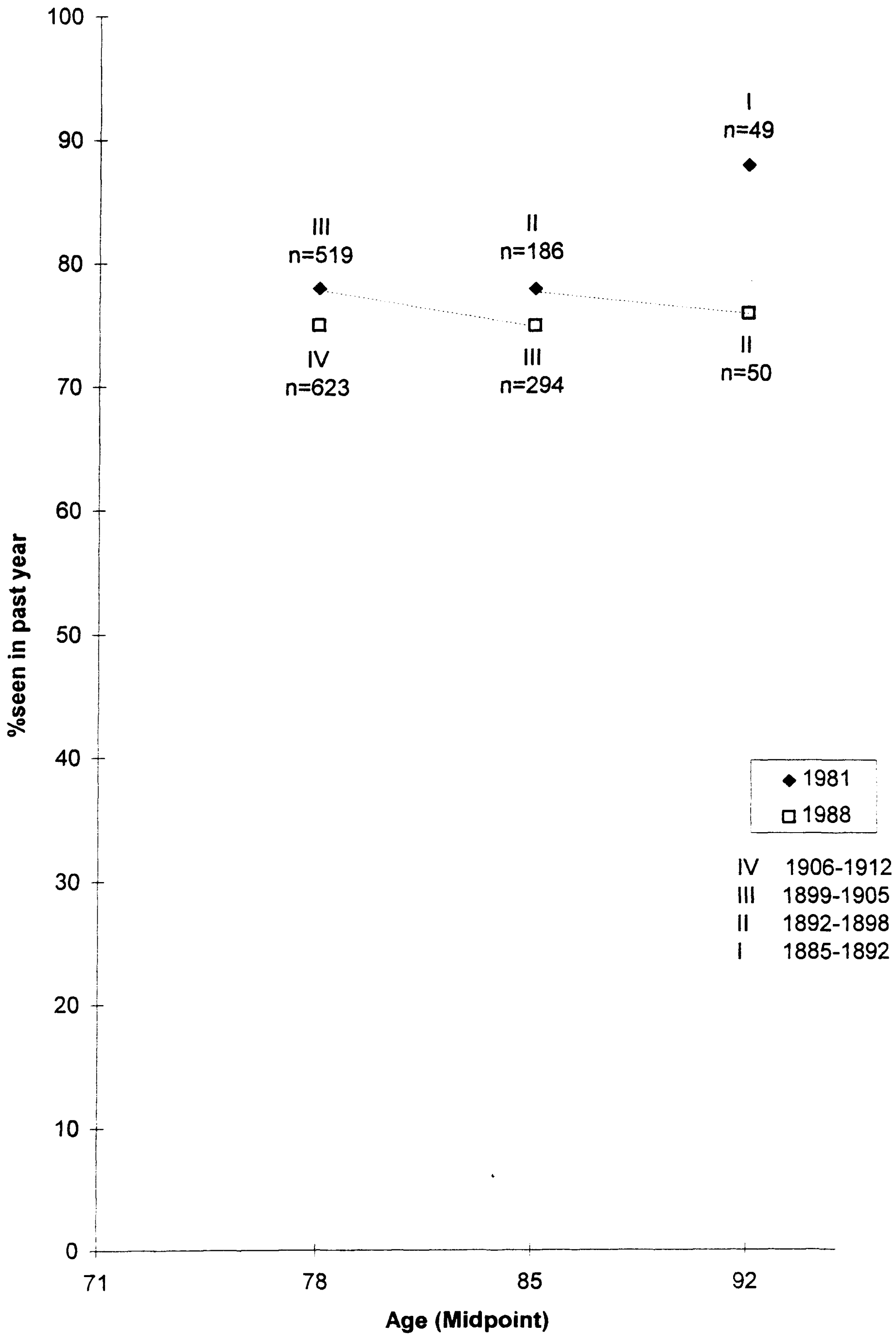
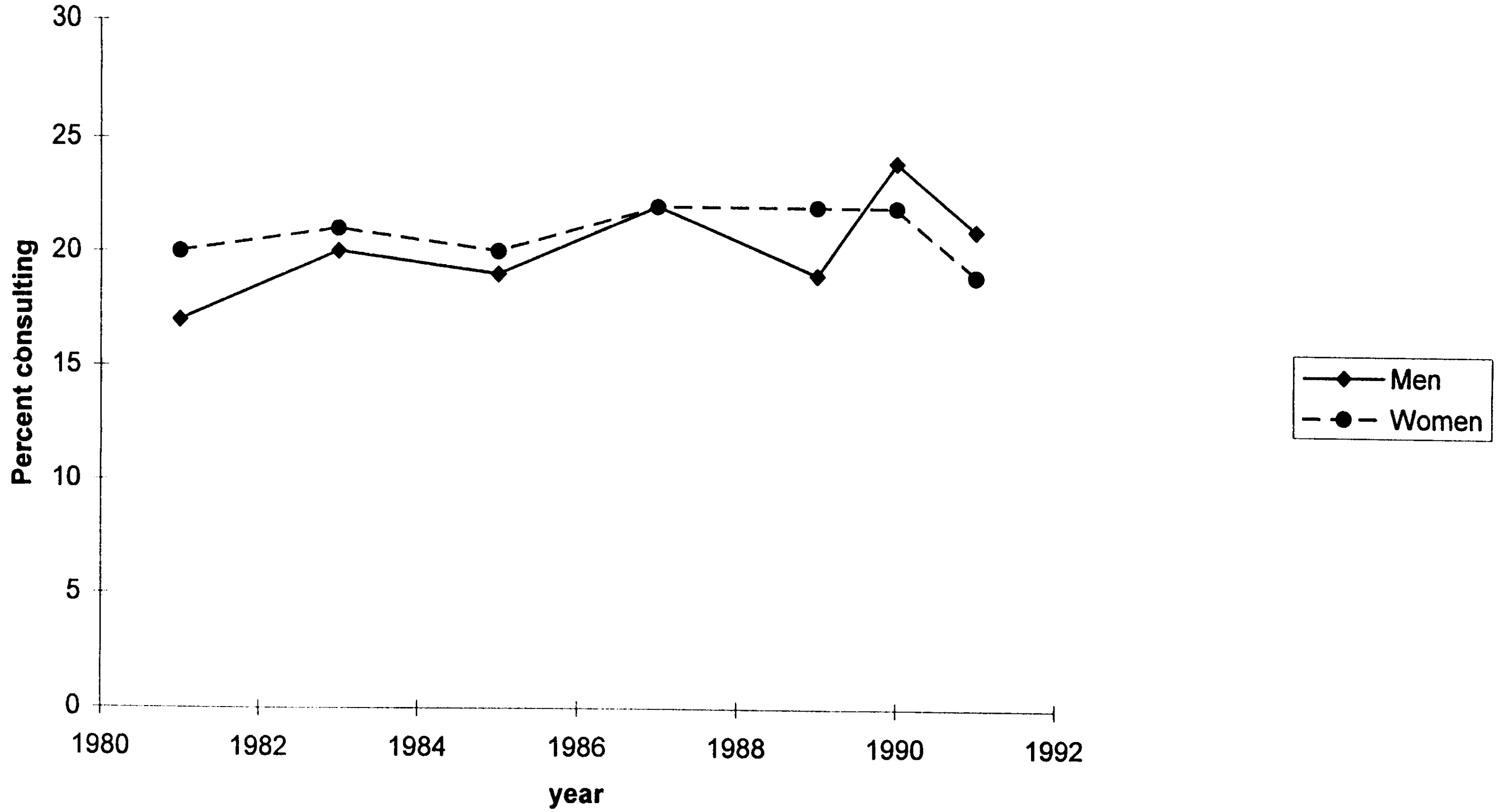


Figure 7.10: Trends in consultation with an NHS GP in the 14 days before interview; GHS 1981-1991



8. DISCUSSION

8.1 Trends in ADL dependency, self-perceived health and GP contact

As women born in 1906-1912 aged into the older age groups, they brought with them lower levels of moderate to severe disability, measured by ADL dependency. The 1906-1912 cohort of men also have lower levels of disability than their precursors when surveyed at age 75-81 years, but these differences are somewhat smaller than for the women, and do not reach statistical significance. In terms of functional ability, once the rightwards shift of the age distribution is allowed for, the elderly population of 1988 was at least as able, if not more so, than that of 1981.

This finding contrasts with conclusions from self-ratings of health. Although the 1906-1912 cohort were, in aggregate, more functionally able, they were significantly more likely to describe their health as being less than good. Moreover, the decline in levels of self-perceived health is graduated across cohorts, with successively higher proportions of respondents with good self-perceived health in cohorts born in 1906-1912, 1899-1905 and 1892-1898. The decline in average levels of perceived health, in the face of apparent improvement in health on more objective measures is perplexing, but finds some echoes in US data. Validity of self-perceived health as an indicator of population health, because of the accumulated evidence that less than good self-perceived health is an important predictor of mortality, is reviewed in Chapter 5.

Interrelationships between cohort differences in the proportion of older people reporting contact with a GP in the past month and self-perceived health, were also investigated. In the female population, the trend in self-perceived health was not reflected in rates of GP contact; rates of contact were stable across cohorts, and as the cohorts aged. However, for men there was a marked statistically significant trend, with higher levels of reported contact amongst the newer cohorts, and trends in self-perceived health and trends in GP contact were closely associated. When the cohorts were further subdivided by self-perceived health status, the increasing trend in the proportion with GP contact was apparent only when subgroups of men in less than good self-perceived health were compared.

Despite a slight reduction in disability prevalence, trends in self-perceived health and GP contact suggest that men aged 75-81 years in 1988, as a group, were more frail than the preceding cohort, interviewed in 1981. They also had lower probability of five-year survival. It is not clear whether this apparent reversal of previous health gains is specific to the study population. However, recent mortality figures for England and Wales give some indication that the trend may be more general. Calculation of three-year moving averages for male mortality rates at age 85 years and over suggests that the long-term decrease in rates may have bottomed out in the early 1990's (ONS General Mortality Statistics Series DH1 No. 29). However, the effects of the changed age distribution amongst this age group are unknown. There is also some evidence of a steeper increasing trend in prevalence of limiting longstanding illness for men than for women in the GHS between 1981 and 1989.

8.2 Limitations of the study

The finding of intercohort differences in self-perceived health and GP contact may be subject to bias from a number of sources. In brief these are: effects of non-contact, migration and institutionalisation; effects of the definition of 7-year birth cohorts; inability to account fully for migration and survival effects arising from the use of cross-sectional surveys; measurement of a restricted range of covariates; limitations of the statistical modelling, and questions of reliability and validity of the measures.

A slightly higher proportion of the population was lost through death before the interview, refusal or other non-contact in 1988 compared to 1981 (16% compared to 9%). This was largely attributable to an increase from 4% to 7% in the proportion dying before interview, and also to an increase in the proportion untraceable, from 1% to 4%. However, any systematic effect from this would be small, suggesting that the trends in self-perceived health may be understated, as people lost to the survey might be expected to be in poor health.

Fixed availability of institutional places across the two surveys implies that the threshold of disability resulting in admission to residential or nursing home care became more severe over the survey period. This might be expected to result in an increase in levels of disability in the community-dwelling population in 1988, although there may also be increased migration to facilities outside of Melton, perhaps reflected in the increase in untraceables. Trends in health of the community-based population may be attributable to the interplay of fixed supply and rising demand for long-term care. However, further investigation, using projected age-sex rates of institutionalisation from 1981, described in Chapter 5, suggested that this effect was small.

Analyses based upon incomplete data on immigration, reported in more detail in Chapters 4 and 5, suggest that there is no substantial effect upon the conclusions. Unfortunately, no information is available on out-migrators. It is possible, but not particularly plausible, that the trend in self-perceived health may be due to emigration of fitter members of the Melton elderly population between 1981 and 1988. This would seem unlikely, given that a likely reason for out-migration in this age group would be to residential accommodation, or to accommodation near children because of widowhood or declining health.

Although a small difference in levels of ADL disability between cohorts born in 1899-1905 and 1906-1912 is established, the size of the difference varies according to the definition adopted for ADL dependency. Issues relating to measurement of disability are dealt with in detail in Chapter 4. With regard to self-perceived health, dichotomisation into good and fair/poor may have resulted in some loss of information. In US surveys, self-perceived health is often characterised as excellent, very good, good, fair or poor, and use of a wider range of categories may have discriminated more finely, allowing the question of shifts in the frame of reference between the surveys to be investigated in more detail. Roughness of the dichotomisation of self-perceived health would be expected to suppress trends in self-perceived health, rather than magnify them. It is also necessary to take into account that the prevalence of GP contact is derived from self-reports. Conclusions on GP contact are restricted by the absence of measures of the number and type of contacts. Further issues relating to measurement of GP contact are dealt with in Chapter 6.

The analysis of data collected at two distinct occasions from the same geographically defined population raises specific methodological issues. The criterion of statistical significance has been used to calculate confidence intervals, treating the population of Melton Mowbray as a pseudo-random sample from the population of England and Wales. Generalisability of the findings depends upon the extent to which this assumption is upheld. It may be that trends are determined by features of the population specific to Melton Mowbray. For example, the general practice moved in 1982 to Latham House, a brand new purpose-built surgery with greatly improved facilities which may of itself have resulted in some shifts in patterns of GP use.

A further potential drawback of the population laboratory approach is that the population may become untypical through being continually studied. However, the burden of studies in this population between 1981 and 1988 was not particularly great, with most of the work being directly related to the two cross-sections and a five-year follow-up of the first cross-section, in 1985. There was one intervention study in the relevant period, of social interventions, randomised in 1985 (Clarke, Clarke and Jagger, 1992). The trial result was negative overall at three-year follow-up in 1988, and the numbers involved were quite small (n=261 in the intervention group), but amongst the endpoints, there was a single significant positive effect of the intervention, upon self-perceived health. This suggests that, in the absence of the trial, the trend towards worse self-perceived health would have been even steeper.

Odds ratios and confidence intervals were calculated using generalised linear models with logit link (Aitken et al, 1989). These models treat the proportion of respondents with a given outcome, in each subgroup by age, and cohort or survey as realisations of a binomial random variable with means specified by the model. It is assumed that individuals are independent and, within each subgroup, have identical risk of less than good self-perceived health. This assumption of homogeneity is clearly a simplification. The standard errors may be understated due to unexplained heterogeneity, attributable to measured or unmeasured covariates. The influence of covariates which were measured and for which there was theoretical justification for a relationship with the outcome variable, such as living arrangements and social class, was investigated in secondary analyses. The influence of unmeasured covariates is of course unknown, but the G^2 values, which are of a similar order of magnitude to the degrees of freedom, suggest that the assumption of homogeneity within groups is tenable for these data. It does however follow, from this rather gross assumption, that the objective of the modelling process is not explanation, but identification of potentially significant differences, for the purpose of hypothesis generation.

Limitations of age-period-cohort analysis are reviewed in Chapter 2, and the approach adopted here does not attempt to separate period and cohort effects empirically. Age-cohort and period differences are estimated separately from age-cohort and age-period models. Period-cohort models are discounted, assuming that period and cohort effects are superimposed upon some underlying effect due to ageing. With only two time periods, the age-period models are equivalent to the drift model of Clayton and Schifflers (1987), and therefore the existence of some trend, whether attributable to period or cohort, is firmly established.

It should also be noted that the range of measured covariates was rather limited, reflecting the age of the 1981 survey. Whilst trends in ADL dependency, self-perceived health and GP contact stand, interpretation, and in particular the task of distinguishing between cohort and period effects would have been strengthened by availability of further measures. The limited information available on socioeconomic status is perhaps the most serious omission, and it would also have been useful to relate the trend in self-perceived health to trends in level of education. Measures of service use are also somewhat limited. Given measures of contact with secondary care, the possibility of shifts in the primary/secondary interface could have been investigated.

Overall, the aspect of methodology that probably has most significant implications for the robustness of the findings is the limitation to two timepoints, with seven-year timespan between the linked cross-sectional surveys. It is possible that high levels of less than good self-perceived health amongst the younger elderly in 1988 represent an isolated event, rather than an underlying trend. The time series for prevalence of longstanding illness and limiting longstanding illness in the GHS peaks in the late 1980s, so the choice of survey date may have exaggerated the trends. The high prevalence of ill-health in 1988 is not attributable to seasonal effects, as interviewing was concentrated in the first half of the year at both surveys. Average monthly temperature was mostly normal for the first six months of 1981, and slightly above normal for the corresponding months of 1988, with no evidence of any periods of particularly severe weather which may have had a bearing upon morale or health (Meteorological Office Reports).

In sum, the present study provides persuasive evidence of trends in prevalence of self-perceived health and self-reported GP contact, but restriction to two timepoints, and a single population raise some questions about generalisability and further work is necessary to establish whether the differing trends in ADL dependency and self-perceived health are sustained.

8.3 Accounting for trends in ADL dependency, self-perceived health and GP contact: physical health

Given an increasing trend in prevalence of less than good self-perceived health, how might this arise? It is suggested by Idler and Benyamini (1997), that the global self-perceived health question cedes control over meaning to the respondent, so that the range of health-related factors which are suggested as resulting in attributions of less than good self-perceived health is wide (Table 8.1). Explanations for the relatively poor levels of self-perceived health amongst the 75-81 year-olds in 1988, drawing upon these factors, may be divided into hypotheses postulating changes in morbidity and mortality related to common health problems, dealt with in this section, and hypotheses citing systematic changes in the way that people perceive and report their health, relating to psychosocial factors and the environment, dealt with in section 8.4.

The threshold of dependency in basic ADL is located at the more severe end of a disability continuum. Even at age 75 years and over, only 19.5% of respondents are classified as dependent. People who are classified as independent in ADL may have health impairments which do not interfere with performance of basic ADL, but nevertheless restrict activity in a less severe manner, for example through inability to perform IADL. These may indicate longstanding conditions, such as arthritis or breathlessness, which interfere quite badly with daily activities and could be reflected in reports of poor or fair health. Increased prevalence of mild disability, accompanying a decrease in prevalence of more severe disability, has been reported elsewhere (Crimmins, Saito and Ingegneri, 1989; Van Boshuisen and Van de Water, 1994).

There have been increases over the 1980s in the prevalence of longstanding illness. For example, in the General Practice Morbidity Survey, based upon a broadly representative sample of volunteer practices, increases in prevalence of more than 30% between 1981/82 and 1991/92 were recorded for a variety of conditions, including diabetes, gout, cataract, angina pectoris, cerebrovascular disease and acute bronchitis (McCormack, Fleming and Charlton, 1995). An increase in the overall burden of chronic disease in the 1980s is supported by the time series for limiting longstanding illness in the GHS (GHS, 1991), although the increasing trend peaked in 1988 and prevalence of limiting longstanding illness has since declined.

Increased prevalence of less than good self-perceived health in the cohort born in 1906-1912 was more apparent amongst the elderly men who were dependent in ADL, suggesting that self-perceived health is not simply capturing loss of function at a milder level, but is giving information upon some other dimension of ill-health. The trend in self-perceived health may indicate differences in the mix of impairments which identify the population who are dependent in ADL. In order to assess this hypothesis, evidence for trends in incidence and case fatality for cancer, cardiovascular disease and respiratory disease was reviewed.

Using data from ONS mortality and cancer registration files, Swerdlow, Doll and dos Santos Silva (1997) review trends for all cancers, and cancers at specific sites since

1970. For men, the period 1970-1989 saw increasing incidence of cancer in the age groups 50-69 years and 70-84 years, but only matched by increased mortality amongst men aged 70-84 years. Amongst men aged 50-69 years, mortality from all cancers fell. Cancer diagnosis is associated with poor self-perceived health, so increased incidence of cancer amongst 70-84 year-olds will have a direct effect upon prevalence of less than good self-perceived health. Furthermore, decline in the mortality:incidence ratio suggests that the new 75-year olds in 1988 include a number of men who owe their lives to improved survival from cancer attributable to advances in treatment, whose history of cancer may predispose them to report less than good health. The decline in the mortality:incidence ratio for all cancers is greater amongst the men. For women aged over 50 years, incidence and mortality increased together throughout the 1970s and 1980s (Charlton and Murphy, 1997). Lung cancer mortality rates in men peak in the cohorts born around 1900, suggesting that the smoking epidemic has maximum impact in this cohort (Doll, Darby and Whitley, 1997). However much of the subsequent reduction in tobacco consumption is due to substitution of low tar cigarettes rather than smoking cessation, so the disease burden associated with smoking may not be reduced in the case of all smoking-related diseases.

Lack of sufficiently detailed incidence data make it difficult to assess the contribution of trends in the cancer burden. However, these effects may be reinforced by similar trends in cardiovascular disease, reviewed by Charlton et al, (1997). UK mortality data show increasing rates in middle-aged men up until the 1970s. This contrasts with the female population, where mortality has declined steadily since the 1940s. Between 1951 and 1971, the sex ratio for male:female IHD deaths increased from 3.0 to 3.8 in the 55-64 year-old age group, and from 2.1 to 2.9 amongst the 65-74 year-olds. Whilst rates for stroke fell in both male and female populations, there was a slight increase in the sex ratio. Although these figures suggest some divergence of trends in cardiovascular disease burden between male and female populations, more complete data on incidence and case fatality are required to confirm this.

In addition to peaking of the epidemic of smoking-related diseases in men, there are some other conditions which are likely to have made a reduced contribution to the burden of ill-health in 1988. In particular, the cohorts born around 1900 bore the brunt of disability related to World War I compared to the cohort born 1906-1912, who were too young to be enlisted. The younger cohort also benefited from improvements in health and safety at work, indicated by a steep fall in the average annual number of fatal accidents of work, through the 1910s to 1960s (Nicholl and Coleman, 1997).

A combination of all these effects may have contributed to a substitution effect in the mix of impairments present amongst the male population defined by dependence in ADL. It is hypothesised that men with long-term physical disabilities, related to war or occupation, and thus relatively well-adjusted to their capabilities, and often subscribing to a culture which minimises difficulties, were dying out as the 1980s progressed to be replaced by cohorts of new elderly, sharing less of this robust culture and beset by conditions of more recent onset and sinister portent. However, assessment of the evidence is inhibited by difficulty in accounting for comorbidity, so that trends relating to the varying conditions cannot be simply aggregated. The increase in less than good self-perceived health may itself be directly associated with an increase in prevalence of comorbidity. For Idler and Benyamini (1997) "while researchers are measuring the parts, respondents have access to the whole". Further research into the meaning that respondents attribute to their responses to questions about global self-perceived health may throw further light upon this question (Jylhä, 1994).

8.4 Accounting for trends in ADL dependency, self-perceived health and GP contact: health perceptions and mental health

It has been suggested that increases in prevalence of self-reported conditions may reflect changes in the threshold at which people start to report health problems (Idler and Angel, 1990; Grundy (1997) Health of Adult Britain). One reason for threshold change may lie in differences in the aggregated life experience of the cohorts. Those born around 1900 lived as adults through two World Wars, and many cohort members were responsible for growing families at the time of the Great Depression. The welfare state came relatively late into their lives. Although the shift in years is relatively small, the cohort born in 1906-1912 were too young to fight in World War I, and experienced the

Great Depression at a younger age. They were also accustomed to the security of mind offered by the NHS from middle-adulthood. The result of these factors may have be less stoicism, coupled with higher expectations of health and healthcare in the newer cohorts.

These cohort effects may be reinforced by more recent influences upon self-perceived health, as discussed in Chapter 5. Changes in visibility of elderly people in the media, together with attempts to challenge unfavourable stereotypes have opened up the possibility of a more active old age, which may lead elders to demand a better standard of health. This may also be accompanied by greater health awareness (Barsky, 1988). Increased health promotion may itself have affected health ratings (Becker, 1993). In the US, an apparent period effect has been tentatively attributed to the effects of the reforms of medicare introduced by the Reagan government in the early 1980s (Wolinsky, 1990), suggesting that levels of self-perceived health in the population may be responsive to external changes in political and cultural environment.

It is at least possible that this effect is echoed in the present data. In the UK, the 1980s were also time of considerable public discussion about the task of maintaining support for elderly people, and doubts expressed in public debate about the future of the welfare state. The surveys in Melton gave some indication of a fixed supply of services, with regard to institutional places, appliances, and staffing in the case of district nurses. Fixed supply presumably met increased demand due to the changes in population age structure, but the effect upon levels of self-perceived health is unknown. However, if real or perceived pressure on resources were a major contributor to the inter-cohort difference, some reduction in the strength of association between self-perceived health and mortality might be expected.

Any association between less than good self-perceived health and the physical or cultural environment may be mediated through effects on morale. There is evidence that less than good self-perceived health is associated with depression (Mulsant, Ganguli and Seaberg, 1997; Kivinen et al, 1998), but data relating to trends in psychiatric morbidity are relatively scarce. Cohorts born around 1885, 1895, 1905 and

1915 have successively lower incidence of suicide at ages 70 years and above (Murphy, Lindesay and Grundy, 1986). However, there is no direct correspondence with trends in depression, as much of the decline is attributed to detoxification of domestic gas. Evidence for an increase in major depressive disorder has been reported in the US, but the oldest cohort studied was born in 1906-1915 (Warshaw, Klerman and Lavori, 1991).

Whilst a trend in self-perceived health of the elderly population is established, the above discussion indicates that the data and theory base are insufficient to discriminate between a range of competing explanations for this trend. Nevertheless, there are useful implications of the results for both policy and further research.

8.5 Implications for policy and further research

Although published GHS data, together with the results presented here, are suggestive of an increased levels of mild ill-health and GP contact in the 1906-1912 cohort, compared to preceding cohorts, evidence is not yet conclusive. Further validation would involve quasi-cohort analysis on the GHS to investigate recent trends in longstanding and limiting longstanding illness, self-perceived health and GP contact. The same data could also be used to relate self-perceived health to trends in use of other health services and domicilliary care, although preliminary investigation suggests that, not unexpectedly, receipt of domicilliary care is much more closely related to ADL dependency than to self-perceived health (Neale, 1997).

If a long-term trend in the self-perceived health of elderly people is established, then the associations with GP contact and mortality underline the relevance of this trend for policy and planning. Uncertainty as to the nature of the shifts in health and disease burden which underlie this trend are an important limitation, but some conclusions for policy may be drawn. Essentially, the findings imply that mixed trends in population health at different levels should be allowed for in-service planning.

Lack of a trend in ADL dependency suggests that the contribution of cohort differences to projections of need for long-term care will be minor, so that the major ingredients for projection will be demographics and availability and acceptability of alternative forms of care. By contrast, the trend in self-perceived health, if sustained, suggests that projections of demand for primary care based simply upon demographic factors may be over-optimistic. The present study is focused upon primary care, and lacks comparable measures so that implications for rates of use of secondary care cannot be explored. The extent of implications for secondary care is unknown, depending upon the relative contribution of the alternative hypotheses postulating increased mild ill-health or change in the mix of impairments in the more severely disabled population. Similar data on secondary care use would enable this issue to be addressed.

Failure of projections based upon age structure alone to adequately describe demand for primary care is illustrated in Table 8.2. Here, actual numbers of people with self-reported GP contact and percentages are compared with projections, allowing for change in population age structure by application of 1981 age and sex-specific rates to the 1988 population. In other words, the projections assume no cohort differences in rates of contact. As might be expected from the trends in GP contact described in Chapter 7, these projections are reasonably accurate in the case of the female population, but in the male population they considerably understate the rates of contact actually reported. These extra contacts are attributable to shifts in health status within the age groupings, indicated by the increase in prevalence of less than good self-perceived health. The number of extra men with contact in the past month is quite large, and results in a considerable shift in the ratio of women to men with contact (Table 8.3). However, the clinical and resource impact of these extra contacts is hard to quantify because, aside from the need to account for errors due to self-report, the fact, rather than the number or nature of contacts, was reported.

Projections of 1988 GP contact based simply on demographics from a 1981 base are optimistic, due to an increase in the prevalence of ill-health of a relatively mild nature, indexed by self-perceived health. However, before self-perceived health is used as a base for projections, more needs to be known about the aspects of health captured by this variable. The seven-year interval between surveys means that the temporal relationship between less than good self-perceived health and GP contact could not be examined. It is therefore possible that less than good self-perceived health is simply a by-product of GP contact in the male population, and not a predictor. Although the growing self-perceived health literature provides evidence that associations with future decline in health and mortality are enduring, it remains necessary to be assured that standard shift is not going to erode the value of self-perceived health as a predictor of future health. Possible explanations for the trend in self-perceived health reviewed in the previous sections include period effects due to changes in prevailing social and environmental conditions, which may be reversible, as well as effects due to the accumulated health experience of cohorts. If sizeable period effects could be ruled out, the task of making projections based upon theorised cohort differences would be much simplified.

This study highlights the potential of self-perceived health for population monitoring and prediction, but more work is necessary before this potential can be fully exploited. Findings emphasise the need for reliable and transparent measures of ill-health at a milder level than that captured by basic ADL. Existing measures, based upon of Instrumental Activities of Daily Living, are sensitive to both gender and environment. The importance of self-perceived health as a predictor of mortality and health decline may reflect the low weight given in other measures to comorbidity, and there is a need to develop measures that better reflect this aspect of health.

Because of its all-inclusive nature, ceding control over meaning to the respondent, self-perceived health may be related both to comorbidity, and to the link between morale and physical impairment. More needs to be known about the relationship of self-perceived health to specific morbidities such as cancer, coronary heart disease and depression. For example, interrelationships with depression could be investigated by including self-perceived health as an outcome variable in intervention studies. Research to better understand the process involved when older people are asked to rate their own health may lead to measures that more clearly describe less severe health impairment in old age. Whilst this will, to a large extent, involve qualitative studies, such as that reported by Jylhä (1994), quantitative studies will also needed to establish applicability to more general populations.

In the meantime, whilst the intercohort difference in self-perceived health observed here is not wholly explainable, it is clear that a shift in the health status of the older population took place during the 1980s. This shift is undetected by the measure of basic ADL, has implications for mortality and service use, and may differ in underlying mechanisms between male and female populations. Whilst population ageing has not resulted in a pandemic of serious disability and an explosion of demand for domicilliary and long-term care, it appears that increased survival may have created conditions for increased demand for primary care.

8.6 Summary

This study found mixed trends in the health of the elderly population in the 1980s, with marginal improvement in age-specific prevalence of ADL dependency, but a marked cohort difference in self-perceived health, with prevalence being greater in the newer cohorts, especially for men. The trend in prevalence of less than good self-perceived health was accompanied by increased GP contact and mortality for men, but not for women. The major limitations of the study are restriction to two timepoints and a single geographical population, and inability of the design to discriminate between underlying explanations for the trend in self-perceived health. There is some margin for error due to failure to track participants who departed the practice, but insufficient to call the conclusions into question. Quasi-cohort analysis on the GHS is proposed in order to investigate generalisability and sustainability of the trend in self-perceived health.

Various explanations are postulated for this trend, relating both to changes in incidence of common conditions and disorders, and to factors in the sociocultural and physical environment. The mixed trends in ADL dependency and self-perceived health suggest that whilst demand for long-term care may be predictable from demographic trends, demand for primary care may exceed such predictions by a considerable margin. However, before self-perceived health is used as a basis for predictions, further research is necessary in order to understand the factors underlying this trend.

Table 8.1: Factors suggested as accounting for less than good self-perceived health[1]

Relating to physical health	Psychosocial	Environmental
diagnosed conditions	judgements about severity of illness	lack of resources in the social environment to attenuate effects of ill-health
symptoms, reported and unreported	family history of illness	Cultural and political imagery
activity limitations	perceived trajectory of health	
pain	depression/low morale	
bed days	comparison with peers	

[1] Table constructed with reference to: Benyamini, 1997; Idler, 1993; Liang 1986

Table 8.2: Number and proportion of patients with GP contact in the past month, 1988; actual figures compared to projections based on 1981 rates and population age structure

	N	Proportion with GP contact in the past month					
		Actual		Projected[1]		Actual - Projected	
		Number with contact	%[2]	Number with contact	%[3]	Number with contact	% error (base=actual)
Women							
75-81	623	193	31	193	31	0	0
82-88	294	85	29	71	24	14	16
89-95	50	13	26	17	34	-4	-31
Total	967	291	30	281	29	10	3
Men							
75-81	378	129	34	106	28	23	17
82-88	134	50	37	34	25	16	32
89-95	11	4	36	2	18	2	50
Total	523	183	35	142	27	41	22

[1] Projected numbers and percents calculated by applying 1981 age and sex-specific rates to the 1988 base population

[2] 1988 age- and sex-specific rate

[3] 1981 age- and sex-specific rate

Table 8.3: Sex-ratio for self-reported contact with a GP in the past month

	Ratio of women to men reporting contact with a GP in the past month
1981	2.21
1988 projected[1]	1.98
1988 actual	1.59

[1]Applying 1981 age- and sex-specific rates to 1988 population

9. CONCLUSIONS

Based upon the Melton Mowbray linked cross-sectional surveys, this thesis reports a stable or downwards trend in age-specific prevalence of dependency in basic Activities of Daily Living in the population aged over 75 years, suggesting that the need for long-term and domicilliary care may not exceed projections based upon age-sex distributions alone. However, there was a contrasting trend in self-perceived health, with surviving members of cohorts born 1892-1898, 1899-1905 and 1906-1912, successively more likely to rate their health as less than good, when interviewed aged 75 years and over. Predictive validity of self-perceived health was confirmed by associations with five-year survival of similar strength in 1981 and 1988 for people aged 75-81 years.

In men, increased prevalence of less than good self-perceived health was accompanied by increased rates of contact with a GP across all cohorts. The youngest cohort of men, interviewed aged 75-81 in 1988, had particularly high rates of contact, closely associated with less than good self-perceived health. This group also had lower five-year survival than men of similar age interviewed in 1988, reversing mortality gains that have been maintained throughout the 20th Century. For women, age-specific rates of GP contact were stable, despite increased prevalence of less than good self-perceived health.

The results suggest that the challenge for health services presented by new cohorts of older people will impact in particular upon primary care, at least for men, and indicate systematic differences by gender in the pattern of interrelationships between self-perceived health, GP contact and survival, worthy of further investigation. Competing explanations for the trend in self-perceived health include increased prevalence of depression, changes in incidence of and survival with common physical conditions, and influences of the political and cultural environment. The results illustrate the potential of such time series to inform both understanding of the ageing process and policy and planning, but in order to fully exploit this potential, improved understanding of the underlying reasons for the trend in self-perceived health, coupled with more transparent measures of mild and moderate ill-health in the older population, are required.

BIBLIOGRAPHY

MSP: A Program for Mokken Scale Analysis for Polytomous Items. Anonymous (1984) iec ProGamma, PO Box 841, 9700 AV Groningen, Netherlands.

GLIM4. Anonymous (1992) London: The Royal Statistical Society.

Agresti, A. (1990) *Categorical Data Analysis*, New York: Wiley.

Aitkin, M., Anderson, D., Francis, B. and Hinde, J. (1989) *Statistical Modelling in GLIM*, Oxford: Clarendon Press.

Andersen, R. and Newman, J.F. (1973) Societal and Individual Determinants of Medical Care Utilization in the United States. *Millbank* 95-124.

Anttila, S. (1991) Functional Capacity in Two Elderly Populations Aged 75 or Over: Comparisons at 10 Years' Interval. *J Clin Epidemiol* **44** (11):1181-1186.

Askham, J., Barry, C., Grundy, E., Hancock, R. and Tinker, A. (1988) *Life after 60: A profile of Britain's older population*, Kings College, London: Age Concern Institute of Gerontology.

Baker, D.I. and Pallett-Hehn, P. (1995) Care or Control: Barriers to Service Use by Elderly People. *Journal of Applied Gerontology* **14** (3):261-274.

Barker, D.J.P. and Purslove, D.J. (1994) Mothers, Babies and Illness in Later Life. London: BMJ Publishing Group.

Barsky, A.J. (1988) The Paradox of Health. *The New England Journal of Medicine* **318** (7):414-418.

Bartley, M., Blane, D. and Charlton, J. (1997) Socioeconomic and demographic trends, 1841-1991. In Charlton, J. and Murphy, M. (eds) *The Health of Adult Britain 1841-1994*. ONS Decennial Supplement No. 12. London: The Stationery Office.

Beard, R.E. (1963) Discussion of "Actuarial Methods of Mortality Analysis". *Proceedings of the Royal Society of London Series B* **159** 56-64.

Bebbington, A.C. (1991) The Expectation of Life without Disability in England and Wales: 1976-1988. *Population Trends* **66** 26-29.

Becker, M.H. (1993) A Medical Sociologist Looks at Health Promotion. *Journal of Health and Social Behavior* **34** (March):1-6.

Beckett, L.A., Brock, D.B., Lemke, J.H., Mendes De Leon, C.F., Guralnik, J.M., Fillenbaum, G.G., Branch, L.G., Wetle, T.T. and Evans, D.A. (1996) Analysis of Change in Self-reported Physical Function among Older Persons in Four Population Studies. *Americal Journal of Epidemiology* **143** (8):766-778.

Bennett, K.M. and Morgan, K. (1992) Health, Social Functioning and Marital Status: Stability and Change Among Elderly Recently Widowed Women. *International Journal of Geriatric Pyschiatry* **7** 813-817.

Bernard, S.L., Kincade, J., Konrad, T.R., Arcury, T.A., Rabiner, D.J., Woomert, A., DeFriese, G.H. and Ory, M.G. (1997) Predicting Mortality From Community Surveys of Older Adults: The Importance of Self-Rated Functional Ability. *Journal of Gerontology: SOCIAL SCIENCES* **52B** (3):155-163.

Blazer, D.G. and Houpt, J.L. (1979) Perception of Poor Health in the Healthy Older Adult. *Journal of the American Geriatrics Society* **XXVII** 330-334.

Bone, M.R. (1995) *Trends in dependency among older people in England: a review carried out on behalf of the department of health*, London: HMSO.

Boniface, D.R. and Denham, M.J. (1997) Factors influencing the use of community health and social services by those aged 65 and over. *Health and Social Care in the Community* **5** (1):48-54.

Bowling, A., Farquhar, M. and Browne, P. (1991) Use of Services in Old Age: Data from Three Surveys of Elderly People. *Soc. Sci. Med* **33** (6):689-700.

Bowling, A. and Grundy, E. (1997) Activities of daily living: changes in functional ability in three samples of elderly and very elderly people. *Age and Ageing* **26** 107-114.

Bowling, A.P. (1989) Contact with general practitioners and differences in health status among people aged over 85 years. *Journal of the Royal College of General Practitioners* **39** (February):52-55.

Branch, L.G., Katz S, Kniepmann, K. and Papsidero, J.A. (1984) A Prospective Study of Functional Status Among Community Elders. *AJPH* **74** (3):266-268.

Brockington, C.F. (1996) A Short History of Public Health. (2nd Edition). J. & A. Churchill Ltd.

Callahan, C.M., Hui, S.L., Nienaber, N.A., Musick, B.S. and Tierney, W.M. (1994) Longitudinal Study of Depression and Health Services Use among Elderly Primary Care Patients. *Journal of the American Geriatrics Society* **42** 833-838.

Case, R.A.M. (1996) Cohort analysis of mortality rates as an historical or narrative technique. *Journal of Epidemiology and Community Health* **50** 114-124.

Charlton, J. (1997) Trends in all-cause mortality: 1841-1994 in Charlton, J. and Murphy, M. (eds) *The Health of Adult Britain 1841-1994*. Volume 1. ONS Decennial Supplement No. 12. London: HMSO.

Charlton, J., Fraser, P. and Murphy, M. (1997) Medical Advances and Iatrogenesis. In Charlton, J. and Murphy, M. (eds) *The Health of Adult Britain 1841-1994*. Vol. 1. ONS Decennial Supplement No. 12. London: HMSO.

Charlton, J. and Murphy, M. (1997) Trends in Causes of Mortality: 1841-1994 - An Overview. In Charlton, J. and Murphy, M. (eds) *The Health of Adult Britain 1841-1994*. Vol. 2. ONS Decennial Supplement No. 13. London: The Stationery Office.

Charlton, J., Murphy, M., Khaw, K-T., Ebrahim, S. and Davey-Smith, G. (1997) Cardiovascular Diseases. In Charlton, J. and Murphy, M. (eds) *The Health of Adult Britain 1841-1994*. Vol. 2. ONS Decennial Supplement No. 13. London: The Stationery Office.

Clarke, M. (1995) Population Laboratories and Health Needs Assessment. *International Journal of Epidemiology* **24** (3):S65-S68.

Clarke, M., Clarke, S.J. and Jagger, C. (1992) Social Intervention and the Elderly: A Randomized Controlled Trial. *American Journal of Epidemiology* **136** (12):1517-1523.

Clayton, D. and Schifflers, E. (1987) Models for Temporal Variation in Cancer Rates II: Age-period-cohort models. *Statistics in Medicine* **6** 469-481.

Coleman, D. and Salt, J. (1992) *The British Population: Patterns, Trends and Processes*, Oxford: Oxford University Press.

Cox, B.D., Huppert, F.A. and Whichelow, M.J. (1993) *The Health and Lifestyle Survey: Seven Years On*, Aldershot: Dartmouth.

Cox, D.R. (1972) Regression Models and the Life-Table. *Journal of the Royal Statistical Society Series B* **34** 187-202.

Craig, J. (1987) Changes in the population composition of England and Wales since 1841. *Population Trends* **48** 27-36.

Crimmins, E.M., Saito, Y. and Ingegneri, D. (1989) Changes in Life Expectancy and Disability-Free Life Expectancy in the United States. *Population and Development Review* **15** (2):235-267.

Crimmins, E.M., Saito, Y. and Reynolds, S.L. (1997) Further Evidence on Recent Trends in the Prevalence and Incidence of Disability Among Older Americans From Two Sources: the LSOA and the NHIS. *Journal of Gerontology: SOCIAL SCIENCES* **52B** (2):S59-S71.

Cullen, M., Blizzard, R., Livingston, G. and Mann, A. (1993) The Gospel Oak project 1987-1990: provision and use of community services. *Health Trends* **25** (4):142-146.

Dallosso, H., Morgan, K., Ebrahim, S., Smith, C.W., Bassey, J., Fentem, P.H. and Arie, T.H.D. (1986) Health and Contact with Medical Services among the Elderly in Greater Nottingham. *East Midland Geographer* **9** 37-44.

DeCarli, and La Vecchia, C. (1987) Age, period and cohort models: a review of knowledge and implementation in GLIM. *Revista di Statistica Applicata* **20** 397-410.

Deeg, D.J.H., Kriegsman D.M.W. and van Zonneveld, R.J. (1994) Trends in fatal chronic diseases and disability in the Netherlands, 1956-1993 and projections 1993-1998. In Mathers, C., McCallum, J. and Robine, J-M. (eds) *Advances in health expectancies: Proceedings of the 7th Meeting of the International Network on Health Expectancy (REVES)*, Canberra, February 1994.

Dening, T.R., Chi, L.Y., Brayne, C., Huppert, F.A., Paykel, E.S. and O'Connor, D.W. (1998) Changes in self-rated health, disability and contact with services in a very elderly cohort: a 6-year follow-up study. *Age and Ageing* **27** 23-33.

Derrick, V.P.A. (1927) Observations on (1) Errors of Age in the Population Statistics of England and Wales, and (2) the Changes in Mortality indicated by the national records. *Journal of the Institute of Actuaries* **58** (March):117-159.

Dighe, M.S., Aparasu, R.R. and Rappaport, H.M. (1997) Factors Predicting Survival, Changes in Activity Limitations, and Disability in a Geriatric Post-Stroke Population. *The Gerontologist* **37** (4):483-489.

Doll, R., Darby, S. and Whitley, E. (1997) Trends in Mortality from Smoking-Related Diseases. In Charlton, J. and Murphy, M. (eds) *The Health of Adult Britain 1841-1994.* Vol. 2. ONS Decennial Supplement No. 13. London: The Stationery Office.

Doty, P. (1987) Health status and health services use among older women: an international perspective. *Wld hlth statist.quart.* **40** 279-290.

Dunlop, D.D., Hughes, S.L. and Manheim, L.M. (1997) Disability in Activities of Daily Living: Patterns of Change and a Hierarchy of Disability. *American Journal of Public Health* **87** (3):378-383.

Ebrahim, S., Hedley, R. and Sheldon, M. (1984) Low levels of ill health among elderly non-consulters in general practice. *BMJ* **289** (November):1273-1275.

Everitt, B.S. and Dunn, G. (1991) *Applied Multivariate Data Analysis*, London: Edward Arnold.

Felton, B.J. (1987) Cohort variation in Happiness: Some Hypotheses and Exploratory Analyses. *International Journal of Aging and Human Development* **25** (1):27-42.

Fienberg, S.E. and Mason, W.M. (1985) Specification and implementation of age, period and cohort models. In Mason, W.M. and Fienberg, S.E. (eds*) Cohort analysis in social research: beyond the identification problem.* New York: Springer-Verlag.

Fillenbaum, G.G. (1979) Social Context and Self-Assessments of Health among the Elderly. *Journal of Health and Social Behavior* **20** (March):45-51.

Fischer, G.W. and Molenaar, I.W. (1995) *Rasch Models: Foundations, Recent Developments and Application*, New York: Springer-Verlag.

Fries, J.F. (1980) Aging, Natural Death, and the Compression of Morbidity. *The New England Journal of Medicine* **303** (3):130-135.

Frost. W.H. (1939) The Age Selection of Mortality from Tuberculosis in Successive Decades. *American Journal of Hygiene* **30** 91-96.

Glandon, G.L., Counte, M.A. and Tancredi, D. (1992) An Analysis of Physician Utilization by Elderly Persons: Systematic Differences Between Self-Report and Archival Information. *Journal of Gerontology: SOCIAL SCIENCES* **47** (5):S245-S252.

Glenn, N.D. (1977) *Cohort Analysis*, Beverley Hills: Sage Publications.

Goddard, E. and Savage, D. (1994) *People Aged 65 and Over: A study carried out on behalf of the 1991 General Household Survey*, London: HMSO.

Grant, M.D., Piotrowski, Z.H. and Chappell, R. (1995) Self-Reported Health and Survival in the Longitudinal Study of Aging 1984-1986. *J Clin Epidemiol* **48** (No 3):375-387.

Great Britain Office of National Statistics, Social Survey Division (1998) Living in Britain: results from the 1996 General Household Survey. London: Stationery Office.

Greiner, P.A., Snowdon, D.A. and Greiner, L.H. (1996) The Relationship of Self-Rated Function and Self-Rated Health to Concurrent Functional Ability, Functional Decline, and Mortality: Findings from the Nun Study. *Journal of Gerontology: SOCIAL SCIENCES* **51B** (5):S234-S241.

Gruenberg, E.M. (1977) Failures of Success. *Millbank Memorial Fund Quarterly* **55** 3-24.

Grundy, E. (1997) The health and health care of older adults in England and Wales, 1841-1994. In Charlton, J. and Murphy, M. (eds) *The Health of Adult Britain 1841-1994*. ONS Decennial Supplement No. 13.

Haynes, R. (1991) Inequalities in Health and Health Service Use: Evidence from the General Household Survey. *Soc. Sci. Med.* **33** (4):361-368.

Hattersley, L., Creeser, R. (1995) *Longitudinal Study 1971-1991: History, Organisation and Quality of Data*. Office of Population Censuses and Surveys Series LS No. 7. London: HMSO.

Hays, J.C., Schoenfeld, D.E. and Blazer, D.G. (1996) Determinants of Poor Self-Rated Health in Late Life. *The American Journal of Geriatric Psychiatry* **4** (3):188-196.

Heathcote, C.R. and McDermid, I.M. (1994) Projections of cohort life expectancy based on weighted least squares methods. In Mathers, C., McCallum, J. and Robine, J-M. (eds) *Advances in health expectancies: Proceedings of the 7th Meeting of the International Network on Health Expectancy (REVES)*, Canberra, February 1994.

Heistaro, S., Vartiainen, E. and Puska, P. (1996) Trends in Self-Rated Health in Finland 1972-1992. *Preventive Medicine* **25** 625-632.

Hobcraft, J., Menken, J. and Preston, S. (1985) Age, period and cohort effects in demography: a review. In Mason, W.M. and Fienberg, S.E. (eds*) Cohort analysis in social research: beyond the identification problem.* New York: Springer-Verlag.

Idler, E.L. (1993) Age Differences in Self-Assessments of Health: Age Changes, Cohort Differences, or Survivorship? *Journal of Gerontology: SOCIAL SCIENCES* **48** (No 6):S289-S300.

Idler, E.L. and Angel, R.J. (1990) Self-Rated Health and Mortality in the NHANES-1 Epidemiologic Follow-up Study. *AJPH* **80** (4):446-452.

Idler, E.L. and Benyamini, Y. (1997) Self-rated Health and Mortality: A Review of Twenty-seven Community Studies. *Journal of Health and Social Behavior* **38** 21-37.

Idler, E.L. and Kasl, S.V. (1995) Self-Ratings of Health: Do They Also Predict Change in Functional Ability? *Journal of Gerontology: SOCIAL SCIENCES* **50B** (6):S344-S353.

Iliffe, S., Tai, S.S., Haines, A., Booroff, A., Goldenberg, E., Morgan, P. and Gallivan, S. (1993) Assessment of elderly people in general practice. 4. Depression, functional ability and contact with services. *British Journal of General Practice* **43** (September):371-374.

Jagger, C., Clarke, M. and Clarke, S.J. (1991) Getting Older - Feeling Younger: The Changing Health Profile of the Elderly. *International Journal of Epidemiology* **20** (1):234-238.

Jagger, C., Clarke, M. and Davies, R.A. (1986) The Elderly at Home: Indices of Disability. *Journal of Epidemiology and Community Health* **40** 139-142.

Jagger, C., Spiers, N. and Clarke, M. (1993) Factors Associated with Decline in Function, Institutionalization and Mortality of Elderly People. *Age and Ageing* **22** 190-197.

Jarvis, C. Trends in old age morbidity in Great Britain. Working Paper No. 11. Age Concern Institute of Gerontology, Kings College London.

Jette, A.M. (1994) How Measurement Techniques Influence Estimates of Disability in Older Populations. *Soc. Sci. Med.* **38** (7):937-942.

Johnson, R.J. and Wolinsky, F.D. (1994) Gender, Race, and Health: The Structure of Health Status Among Older Adults. *The Gerontologist* **34** (1):24-35.

Jylhä, M. (1994) Self-Rated Health Revisited: Exploring Survey Interview Episodes with Elderly Respondents. *Soc. Sci. Med.* **39** (7):983-990.

Jylhä, M. (1994) Ten-year change in the use of medical drugs among the elderly - a longitudinal study and cohort comparison. *J Clin Epidemiol* **47** (1):69-79.

Jylhä, M., Guralnik, J.M., Ferruci, L., Jokela, J. and Heikkinen, E. (1998) Is Self-Rated Health Comparable Across Cultures and Genders? *Journal of Gerontology: SOCIAL SCIENCES* **53B** (3):S144-S152.

Kaplan, G.A. and Camacho, T. (1983) Perceived Health and Mortality : A nine year follow up of the human population laboratory cohort. *American Journal of Epidemiology* **117** (3):292-303.

Kaplan, G.A., Goldberg, D.E., Everson, S.A., Cohen, R.D., Salonen, R., Tuomilehto, J. and Salonen, J. (1996) Perceived Health Status and Morbidity and Mortality: Evidence from the Kuopio Ischaemic Heart Disease Risk Factor Study. *International Journal of Epidemiology* **25** (2):259-265.

Katz, S. and Akpom, C.A. (1976) A Measure of Primary Sociobiological Functions. *International Journal of Health Services* **6** (3):493-507.

Katz, S., Ford, A.B., Moskowitz, R.W., Jackson, B.A. and Jaffe, M.W. (1963) Activities of Daily Living (ADL). *Journal of the American Medical Association* **185** 914-919.

Katz, S., Ford, A.B., Moskowitz, R.W., Jackson, B.A., Jaffe, M.W. and Cleveland, M.A. (1963) Studies of Illness in the Aged. The Index of ADL: A Standardized Measure of Biological and Psychosocial Function. *JAMA* **185** (12):914-919.

Kempen, G.I.J.M., Myers, A.M. and Powell, L.E. (1995) Hierarchical Structure in ADL and IADL: Analytical Assumptions and Applications for Clinicians and Researchers. *J Clin Epidemiol* **48** (11):1299-1305.

Kempen, G.I.J.M., Steverink, N., Ormel, J. and Deeg, D.J.H. (1996) The Assessment of ADL Among Frail Elderly in an Interview Survey: Self-Report versus Performance-Based Tests and Determinants of Discrepancies. *Journal of Gerontology: PSYCHOLOGICAL SCIENCES* **51B** (5):P254-P260.

Kivinen, P., Halonen, P., Eronen, M. and Nissinen, A. (1998) Self-rated health, physician-rated health and associated factors among elderly men: the Finnish cohorts of the Seven Countries Study. *Age and Ageing* **27** 41-47.

Knoke, D. and Hout, M. (1974) Social and Demographic Factors in American Political Party Affiliations 1952-1972. *American Sociological Review* **38** 242-258.

Korteweg, R. (1951) *British Journal of Cancer* **5** 21.

Korteweg, R. (1953) *Acta un International Cancer* 9 529.

Kramer, M. (1980) The rising pandemic of mental disorders and associated chronic diseases and disabilities. *Acta Psychiatrica Scandinavica* **62** (Suppl. 285):382-397.

Krause, N. (1990) Illness Behavior in Later Life. In: Anonymous *Handbook of Aging and the Social Sciences*, Third edn. pp. 227-244.

Krause, N. (1996) Stress, Gender, Cognitive Impairment, and Outpatient Physician Use in Later Life. *Journal of Gerontology: PSYCHOLOGICAL SCIENCES* **51B** (1):P15-P23.

Krause, N.M. and Jay, G.M. (1994) What Do Global Self-Rated Health Items Measure? *Medical Care* **32** (9):930-942.

La Rue, A., Bank, L., Jarvik, L. and Hetland, M. (1979) Health in Old Age: How Do Physicians' Ratings and Self-ratings Compare? *Journal of Gerontology* **34** (5):687-691.

Lawrence, R.H. and Jette, A.M. (1996) Disentangling the Disablement Process. *Journal of Gerontology: SOCIAL SCIENCES* **51B** (4):S173-S182.

Lee, W.C. and Lin, R.S. (1996) Autoregressive Age-Period-Cohort Models. *Statistics in Medicine* **15** 273-281.

Liang, J. (1986) Self-Reported Physical Health Among Aged Adults. *Journal of Gerontology* **41** (2):248-260.

Livingstone, G., Blizard, B., Thomas, A., Graham, N. and Mann, A. (1990) The Gospel Oak Project: the use of health and social services by dependent elderly people in the community. *Health Trends* **22** (2):70-73.

Maddox, G.L. (1962) Some Correlates of Differences in Self-Assessment of Health Status among the Elderly. *Journal of Gerontology* **17** 180-185.

Maddox, G.L. and Clark, D.O. (1992) Trajectories of Functional Impairment in Later Life. *Journal of Health and Social Behavior* **33** 114-125.

Maheswaran, R., Strachan, D.P., Elliott, P. and Shipley, M.J. (1997) Trends in stroke mortality in Greater London and south east England - evidence for a cohort effect? *Journal of Epidemiology and Community Health* **51** 121-126.

Mannheim, K. (1952) The Problem of Generations. In: Anonymous *Essays on the Sociology of Knowledge*, pp. 276-322. New York: Oxford University Press]

Manton, K.G. (1988) A Longitudinal Study of Functional Change and Mortality in the United States. *Journal of Gerontology: SOCIAL SCIENCES* **43** (5):S153-S161.

Manton, K.G. (1982) Changing concepts of morbidity and mortality in the elderly population. *Millbank Memorial Fund Quarterly* **60** 183-244.

Manton, K.G., Corder, L. and Stallard, E. (1997) Chronic disability trends in elderly United States populations: 1982-1994. *Proc.Natl.Acad.Sci.USA* **94** 2593-2598.

Manton, K.G. and Stallard, E. (1991) Cross-sectional Estimates of Active Life Expectancy for the U.S. Elderly and Oldest-Old Populations. *Journal of Gerontology: SOCIAL SCIENCES* **46** (3):S170-S182.

Manton, K.G., Stallard, E. and Corder, L.S. (1998) The Dynamics of Dimensions of Age-Related Disability 1982 to 1994 in the U.S. Elderly Population. *Journal of Gerontology: SOCIAL SCIENCES* **53A** (1):B59-B70.

Manton, K.G., Stallard, E. and Tolley, H.D. (1991) Limits to Human Life Expectancy: Evidence, Prospects, and Implications. *Population and Development Review* **17** (4):603-637.

Mathiowetz, N.A. and Lair, T.J. (1994) Getting Better? Change or Error in the Measurement of Functional Limitations. *Journal of Economic and Social Measurement* **20** 237-262.

McCallum, J., Shadbolt, B. and Wang, D. (1994) Self-Rated Health and Survival: A 7-Year Follow-up Study of Australian Elderly. *American Journal of Public Health* **84** (7):1100-1105.

McCormick, A., Fleming, D. and Charlton, J. (1995) Morbidity Statistics from General Practice. Fourth National Study 1991-1992. Office of Population Censuses and Surveys Series MB5 No. 3. London: HMSO.

McNally, R.J.Q., Alexander, F.E., Staines, A. and Cartwright, R.A. (1997) A Comparison of Three Methods of Analysis for Age-Period-Cohort Models with Application to Incidence Data on Non-Hogkin's Lymphoma. *International Journal of Epidemiology* **26** (1):32-46.

Mechanic, D. (1979) Correlates of Physician Utilization: Why Do Major Multivariate Studies of Physician Utilization Find Trivial Psychosocial and Organizational Effects? *Journal of Health and Social Behavior* **20** (December):387-396.

Mokken, R.J. (1971) *A Theory and Procedure of Scale Analysis*, The Hague: Mouton & Co.

Morgan, K., Dallosso, H., Byrne, E., Arie, T., Jones, R. and Waite, J. (1987) Mental Health and Psychological Well Being Among the Old and Very Old Living at Home. *British Journal of Psychiatry* **150** 801-807.

Morgan, K., Dallosso, H., Ebrahim, S., Arie, T. and Fentem, P. (1987) Mental Health and Contact with Primary Care Services in Old Age. *International Journal of Geriatric Pyschiatry* **2** 223-226.

Mossey, J.M., Havens, B. and Wolinsky, F.D. (1989) The consistency of formal health care utilization: physician and hospital utilization. In: Ory, M. and Bond, K. (Eds.) *Aging and Health Care: Social Science and Policy Perspectives*, pp. 81-98. London: Routledge]

Mossey, J.M. and Shapiro, E. (1982) Self-Rated Health: A Predictor of Mortality Among the Elderly. *AJPH* **72** (8):800-808.

Mulsant, B.H., Ganguli, M. and Seaberg, E.C. (1997) The Relationship Between Self-Rated Health and Depressive Symptoms in an Epidemiological Sample of Community-Dwelling Older Adults. *Journal of American Geriatrics Society* **45** (8):954-958.

Murphy, E., Lindesay, J. and Grundy, E. (1986) 60 Years of Suicide in England and Wales. *Archives of General Psychiatry* **43** 969-976.

Murray, J., Dunn, G. and Tarnopolsky, A. (1982) Self-assessment of health: an exploration of the effects of physical and psychological symptoms. *Psychological Medicine* **12** 371-378.

Mutran, E. and Ferraro, K.F. (1988) Medical Need and Use of Services Among Older Men and Women. *Journal of Gerontology: SOCIAL SCIENCES* **43** (5):S162-S171.

Myers, G.C. and Lamb, V.L. (1993) Theoretical Perspectives on Healthy Life Expectancy. In Robine, J-M., Mathers, C.D., Bone, M.R. and Romieu, I. (eds) *Calculation of Health Expectancies: harmonization, consensus achieved and future perspectives*. 6th REVES International Workshop, Montpellier, October 1992.

Neale, H. (1997) Age-Period-Cohort Analysis of Health Service Utilisation in an Elderly Population. University of Leicester. Master of Science.

Nichol, J. and Coleman, P. (1997) Accidents: Trends in Mortality and Morbidity. In Charlton, J. and Murphy, M. (eds) *The Health of Adult Britain 1841-1994*. Vol. 2. ONS Decennial Supplement No. 13. London: The Stationery Office.

Office of Population Censuses and Surveys (1995) *Living in Britain: preliminary results from the 1994 General Household Survey. London: HMSO.*

Office of Population Censuses and Surveys *Mortality Statistics Serial Tables 1841-1990. Series DH1 No. 25. London: HMSO.*

Office of Population Censuses and Surveys (1991) *The General Household Survey. Report for 1991. London: HMSO.*

Olshansky, S.J., Rudberg, M.A., Carnes, B.A., Cassel, C.K. and Brody, J.A. (1991) Trading Off Longer Life for Worsening Health. *Journal of Aging and Health* **3** (2):194-216.

Omran, A.R. (1971) The Epidemiological Transition: A theory of the epidemiology of population change. *Millbank Memorial Fund Quarterly* **4** (1):509-538.

Omran, A.R. (1983) The Epidemiological Transition Theory - A Preliminary Update. *Journal of Tropical Pediatrics* **29** 305-316.

Osmond, C. and Gardner, M.J. (1982) Age, Period and Cohort Models Applied to Cancer Mortality Rates. *Statistics in Medicine* **1** 245-259.

Palmore, E.B., Nowlin, J.B. and Wang, H.S. (1985) Predictors of Function Among the Old-Old: A 10-Year Follow Up. *Journal of Gerontology* **40** (2):244-250.

Perenboom, R.J.M., Boshuisen, H.C., van de Water, H.P.A. (1993) Trends in health expectancies in the Netherlands, 1981-1990. In Robine, J-M., Mathers, C.D., Bone, M.R., Romieu, I. (eds) *Calculation of health expectancies: harmonization, consensus achieved and future perspectives*. Proceedings of the 6th REVES International Workshop, Montpellier, October 1992.

Pfeiffer, E. (1970) Survival in Old Age: Physical, Psychological and Social Correlates of Longevity. *Journal of American Geriatrics Society* **18** (4):273-285.

Philp, I., McKee, K.J., Meldrum, P., Ballinger, B.R., Gilhooly, M.L.M., Gordon, D.S., Mutch, W.J. and Whittick, J.E. (1995) Community care for demented and non-demented elderly people: a comparison study of financial burden, service use, and unmet needs in family supporters. *BMJ* **310** 1503-1506.

Rakowski, W., Fleishman, J.A., Mor, V. and Bryant, S.A. (1993) Self-Assessments of Health and Mortality Among Older Persons. *Research on Ageing* **15** (1):92-116.

Riley, M.W. (1994) Aging and Society: Past, Present, and Future. *The Gerontologist* **34** (4):436-446.

Riley, M.W. (1973) Aging and Cohort Succession: Interpretations and Misinterpretations. *Public Opinion Quarterly* **37** 35-49.

Riley, M.W., Johnson, M. and Foner, A. (1972) *Aging and Society Volume III: A Sociology of Age Stratification*, New York: Sage.

Ritzer, G. (1996) *Classical Sociological Theory*, 2nd edn. McGraw-Hill.

Robertson, C. and Boyle, P. (1986) Age, period and cohort models: the use of individual records. *Stat. Med.* **5** 527-538.

Robine, J-M. (1994) Disability-free life expectancy trends in France: 1981-1991, international comparison. In Mathers, C., McCallum, J. and Robine, J-M. (eds) *Advances in health expectancies: Proceedings of the 7th Meeting of the International Network on Health Expectancy (REVES)*, Canberra, February 1994.

Rodgers, W. and Miller, B. (1997) A Comparative Analysis of ADL Questions in Surveys of Older People. *Journals of Gerontology* **52B** (Special Issue):21-36.

Rodgers, W.L. (1982) Estimable Functions of Age, Period, and Cohort Effects. *American Sociological Review* **47** 774-787.

Rosenstock, I. (1974) Historical Origins of the Health Belief Model. In: Becker, M. (Ed.) *The Health Belief Mode and Personal Health Behaviour*, pp. 1-8. Thorofare, New Jersey: Slack Press]

Ryder, N.B. (1965) The Cohort as a Concept in the Study of Social Change. *American Sociological Review* **30** 843-861.

Schulz, R., Mittelmark, M., Kronmal, R., Polak, J.F., Hirsch, C.H., German, P. and Bookwala, J. (1994) Predictors of Perceived Health Status in Elderly Men and Women. *Journal of Aging and Health* **6** (4):419-447.

Sijtsma, K. and Molenaar, I.W. (1987) Reliability of Test Scores in Nonparametric Item Response Theory. *Psychometrika* **52** (1):79-97.

Singer, E., Garfinkel, R., Cohen, S.M. and Srole, L. (1976) Mortality and Mental Health: Evidence from the Midtown Manhattan Restudy. *Soc Sci & Med* **10** 517-525.

Slivinske, L.R., Fitch, V.L. and Mosca, J. (1994) Predicting Health and Social Service Utilization of Older Adults. *Journal of Social Service Research* **20** 21-40.

Spector, W.D. and Fleishman, J.A. (1998) Combining Activities of Daily Living With Instrumental Activities of Daily Living to Measure Functional Disability. *Journal of Gerontology: SOCIAL SCIENCES* **53B** (1):S46-S57.

Spector, W.D., Katz, S., Murphy, J.B. and Fulton, J.P. (1987) The Hierarchical Relationship Between Activities of Daily Living and Instrumental Activities of Daily Living. *J Chron Dis* **40** (6):481-489.

Spiers, N., Jagger, C. and Clarke, M. (1996) Physical Function and Perceived Health: Cohort Differences and Interrelationships in Older People. *Journal of Gerontology: SOCIAL SCIENCES* **51B** (5):S226-S233.

Stoller, E.P. (1984) Self-Assessments of Health by the Elderly: The Impact of Informal Assistance. *Journal of Health and Social Behavior* **25** 260-270.

Strain, L.A. (1991) Use of Health Services in Later Life: The Influence of Health Beliefs. *Journal of Gerontology: SOCIAL SCIENCES* **46** (3):143-150.

Strawbridge, W.J., Cohen, R.D., Shema, S.J. and Kaplan, G.A. (1996) Successful Aging: Predictors and Associated Activities. *American Journal of Epidemiology* **144** (2): 135-141.

Strawbridge, W.J., Kaplan, G.A., Camacho, T. and Cohen, R.D. (1992) The Dynamics of Disability and Functional Change in an Elderly Cohort: Results from the Alameda County Study. *JAGS* **40**, 799-806.

Sullivan, D.F. (1971) A Single Index of Mortality and Morbidity. *HSMHA Health Reports* **86** (4):347-354.

Svanborg, A. (1987) The health of the elderly population: results from longitudinal studies with age-cohort comparisons. Chichester: John Wiley and Sons. (1988).

Svanborg, A. (1988) The health of the elderly population: results from longitudinal studies with age-cohort comparisons. In *Proceedings of the CIBA Foundation Symposium, Bethesda, Maryland, 28-30 April 1987*. Chichester: John Wiley and Sons. (1988).

Swerdlow, A., Doll, R. and dos Santos Silva, I. (1997) Time trends in cancer incidence and mortality in England and Wales. In Charlton, J. and Murphy, M. (eds) *The Health of Adult Britain 1841-1994*. Vol. 2. ONS Decennial Supplement No. 13. London: The Stationery Office.

Tessler, R. and Mechanic, D. (1978) Psychological Distress and Perceived Health Status. *Journal of Health and Social Behavior* **19** 254-262.

Thatcher, A.R. (1992) Trends in Numbers and Mortality at High Ages in England and Wales. *Population Studies* **46** 411-426.

Tissue, T. (1972) Another Look at Self-Rated Health Among the Elderly. *Journal of Gerontology* **27** 91-94.

Tsuji, I., Minami, Y., Keyl, P.M., Hisamichi, S., Asano, H., Sato, M. and Shinoda, K. (1994) The Predictive Power of Self-Rated Health, Activities of Daily Living, and Ambulatory Activity for Cause-Specific Mortality among the Elderly: A Three-year Follow-up in Urban Japan. *Journal of American Geriatrics Society* **42** 153-156.

van Doorn, C. and Kasl, S.V. (1998) Can Parental Longevity and Self-Rated Life Expectancy Predict Mortality Among Older Persons? Results from an Australian Cohort. *Journal of Gerontology: SOCIAL SCIENCES* **53B** (1):S28-S34.

Verbrugge (1990) The Iceberg of Disability. In: Stahl, S.M. (Ed.) *The Legacy of Longevity*, Newbury Park: Sage]

Verbrugge, L.M. (1985) Gender and Health: An update on hypotheses and evidence. *Journal of Health and Social Behavior* **26** 156-182.

Victor, C.R. and Vetter, N.J. (1986) Poverty, Disability and Use of Services by the Elderly: Analysis of the 1980 General Household Survey. *Soc. Sci. Med.* **22** (10):1087-1091.

Wan, T.T.H. (1976) Predicting Self-assessed Health Status: A Multivariate Approach. *Health Services Research* (Winter):464-477.

Wan, T.T.H. (1989) The behavioral model of health care utilization by older people. In: Anonymous *Aging and Health Care*, pp. 52-77.

Warshaw, M.G., Klerman, G.L. and Lavori, P.W. (1991) The use of conditional probabilities to examine age-period-cohort data: further evidence for a period effect in major depressive disorder. *Journal of Affective Disorders* **23** 119-129.

Wiener, J.M., Hanley, R.J., Clarke, R. and Van Nostrand, J.F. (1990) Measuring the Activities of Daily Living: Comparisons Across National Surveys. *Journal of Gerontology: SOCIAL SCIENCES* **45** (6):S229-S237.

Winblad, I. (1993) Comparison of the Prevalence of Disability in Two Birth Cohorts at the Age of 75 Years and Over. *J Clin Epidemiol* **46** (3):303-308.

Wolinsky, F.D. (1990) *Health and Health Behavior Among Elderly Americans*, New York: Springer.

Wolinsky, F.D. and Arnold, C.L. (1988) A Different Perspective on Health and Health Services Utilization. *Annual Review of Gerontology and Geriatrics* **8** 71-101.

Wolinsky, F.D. and Arnold, C.L. (1989) A Birth Cohort Analysis of Dental Contact among Elderly Americans. *AJPH* **79** (1):47-51.

Wolinsky, F.D., Arnold, C.L and Nallapati, I.V. (1988) Explaining the Declining Rate of Physician Utilization Amongst the Oldest Old. *Med Care* **26** 544-553.

Wolinsky, F.D., Coe, R.M. and Mosely, R.R. (1987) The use of health services by elderly Americans: implications from a regression-based cohort analysis. In Ward, R. and Tobin, S. (eds) *Health in Aging: Sociological Issues and Policy Directions*. New York: Springer. pp106-132.

Wolinsky, F.D. and Johnson, R.J. (1991) The Use of Health Services by Older Adults. *Journal of Gerontology: SOCIAL SCIENCES* **46** (6):S345-S357.

Wolinsky, F.D., Mosely, R.R. and Coe, R.M. (1986) A Cohort Analysis of the Use of Health Services by Elderly Americans. *Journal of Health and Social Behavior* **27** (September):209-219.

Xu, X., Laird, N., Dockery, D.W., Schouten, J.P., Rijcken, B. and Weiss, S.T. (1995) Age, Period, and Cohort Effects on Pulmonary Function in a 24-Year Longitudinal Study. *American Journal of Epidemiolgy* **141**, 554-566.

Appendix 2A:Generation of hypothetical data for Figure 2.2 from age-cohort and age-period models

For example, consider two equations:

Age-cohort formulation:	rate=20(cohort-1900)+10(age-40)	2Ai
Age-period formulation:	rate=20(period-1900)-10(age-40)	2Aii

Period is indexed by year of observation, and cohort is indexed by birth year. Either of these equations may be used to generate the following set of rates:

	Cohort			
Age	1900	1910	1920	1930
40	0	200	400	600
50	100	300	500	700
60	200	400	600	800
70	300	500	700	900

These rates are plotted in the third example in Figure 2.2.

Appendix 2B: Non-identifiability of the three-factor age-period-cohort model

Consider the model $\log(rate) = \alpha A + \beta P + \gamma C$

where

A=Age achieved in year of observation

P=Year of observation

C=Cohort

α, β, γ are parameters to be estimated.

As A = P - C, the model can be restated

$$\log(rate) = \alpha(P - C) + \beta P + \gamma C$$

$$\Rightarrow \log(rate) = (\alpha + \beta)P + (\gamma - \alpha)C$$

For any given value of α, the equation can be solved to give values of β and γ which generate the linear combination of Period and Cohort which best fits log(*rate*).

Appendix 4A: Item wording for ADL dependency: 1981

Questions were asked for individual activities in the following order:

Question	Activity definition
30.	get in and out of a chair
31.	get in and out of bed
32.	walk up and down stairs
33.	get around the house/flat/home /ward
34.	bath yourself *(if no bathroom, or if bathroom is inaccessible, prompt for strip-wash)*
35.	dress yourself (*including putting on shoes and socks/stockings*)
36.	feed yourself
37.	get yourself to and from the toilet at night

Question 30 is reproduced in full overleaf. Questions 31-37 were identically worded, but for definition of the activity.

Question 30 reproduced in full from schedule for 1981 population survey

30. Do you get in and out of a chair without any help or appliances?

Yes - *go to a.* 0

With help) 1

With appliances) *go to b* 2

With both) 3

Does not get in and out of chair - *go to c.* . . . 4

a. *If yes*

Can I take it that you do not have any appliances to help you get in and out of a chair at the moment?

Has none 0

Has one/some 1

Specify ____________________

____

Do you think you need any help and/or appliances to get in and out of a chair?

Complete this section and go to Interviewer's box.

(No 0
(Yes - help - 1
(*Specify* ____________________
(____________________
(Yes - appliance(s) - . 2
(*Specify* ____________________
(____________________
(Don't know X

Do you think you need any more help and/or appliances to help you get in and out of a chair?

Complete this section and go to Interviewer's box.

(No 0
(Yes - help - *specify* . 1
(____________________
(____________________
(Yes - appliance(s) - . 2
(*specify*
(____________________
(____________________
(Don't know X

b. *If has help and/or appliances*

What help do you have at the moment?

Specify ____________________

____

What appliance(s) do you have at the moment?

Specify ____________________

____

c. *If does not get in and out of chair*

Do you have any appliances which you could use at the moment to help you get in and out of a chair?

Has none 0

Has one/some - *specify* 1

____

____

Do you think you need any (more) help and/or appliances to help you get in and out of a chair?

Complete this section and go to Interviewer's box.

(No 0
(Yes - help - *specify* . 1
(____________________
(____________________
(Yes - appliance(s) - . 2.
(*specify*
(____________________
(____________________
(Don't know X

Appendix 4B: Item wording for ADL dependency: 1988

25. In general, how much difficulty, if any, have you in doing each of the following on your own?

DO YOU	Without difficulty on own	On own with difficulty	Only with help	Only with appliance	With help & appliance	Does not do	Who helps (see codes below*)
a) Wash hands and face?	1	2	3	4	5	6	
b) Have a bath or an all-over wash?	1	2	3	4	5	6	
c) Put shoes and socks/stockings on yourself?	1	2	3	4	5	6	
d) Do up buttons & zips yourself?	1	2	3	4	5	6	
e) Dress yourself other than above?	1	2	3	4	5	6	
f) Get to & from & use the toilet?	1	2	3	4	5	6	
g) Get in & out of bed?	1	2	3	4	5	6	
h) Get in & out of a chair?	1	2	3	4	5	6	
j) Feed yourself?	1	2	3	4	5	6	

* Allow for 2 main helpers

DO YOU	Without difficulty on own	On own with difficulty	Only with help	Only with appliance	With help & appliance	Does not do	Who helps (see codes below*)
k) Shave(men)? Brush hair (women)?	1	2	3	4	5	6	
l) Cut your toenails?	1	2	3	4	0	6	
m) Get up & down steps?	1	2	3	4	5	6	
n) Get around the house?	1	2	3	4	5	6	
p) Get out of doors on own?	1	2	3	4	5	6	

* Allow for 2 main helpers

CODE LIST FOR "WHO HELPS"

Spouse	1
Someone else in household	2
Relative outside household	3
Friend/neighbour	4
Voluntary visitor	5
Home help	6
District Nurse	7
Other(specify)__________	8

Appendix 4C:Standardised coefficients from the principal components analysis for ADL dependency; participants interviewed at home 1981(n=1123) and 1988 (n=1495)

Survey		1981			1988	
ADL	Component 1	Component 2	Component 3	Component 1	Component 2	Component 3
Bed	0.25	-0.11	-0.05	0.25	-0.22	0.08
Chair	0.25	-0.19	-0.05	0.24	-0.15	0.05
Mobility	0.25	-0.13	-0.11	0.22	0.05	-0.34
Dressing	0.24	0.01	0.13	0.24	-0.14	0.07
Bathing	0.13	0.19	-0.62	0.15	0.27	-0.73
Eating	0.16	-0.26	0.56	0.16	-0.18	0.53
Urine	0.11	0.57	-0.24	0.13	0.43	0.26
Faeces	0.08	0.65	0.58	0.06	0.75	0.30
Variance explained (%)	42	14	11	43	13	11

Appendix 4D: Hierarchical properties of the ADL scale

If an ADL hierarchy is an acceptable model, then individual paths through states of disability defined by combinations of impairments will be largely restricted to a few, well-travelled routes and observed combinations of ADL impairments will be few and predictable. This assumption was examined initially through crosstabulations, and further by item response analysis using Mokken Scaling, with the aid of the package MSP (ProGAMMA, 1994). Scalability was assessed using Loevinger's H (Mokken, 1971), an aggregated indicator based on covariance of item pairs. In a hierarchical scale where items tap an underlying unidimensional trait, these covariances are positive. Loevinger's H compares the frequency of 'errors' , in other words, responses not conforming to a hierarchical scale, to the frequency expected under a model where responses to the items are independent. For example, a participant who was dependent in eating, but independent in mobility would be classified as an error, being assessed as disabled on the diagnostic test for most severe disability, but nondisabled on a test for more moderate disability. Loevinger's H is calculated using the following formula:

$$H = 1 - \frac{F}{E}$$

where F is the observed number of errors and E is the number of errors that would be expected under a conditional independence model where responses to individual items are independent, conditional upon the overall level of disability defined by the individual's number of ADL dependencies.

The scalability coefficient may also be calculated for individual items, with negative item scalabilities indicating idiosyncratic items. H assesses departure from the conditional independence model in a manner that is analogous to use of Kappa (Cohen, 1969) in a 2 by 2 table. Mokken (1971 pp185) proposes that criteria for an acceptable scale should be an overall scalability coefficient of more than 0.5, together with no individual item scalability less than 0.3. In addition, the underlying assumptions of the model were tested as described below. Internal consistency was assessed using the reliability coefficient of Sijtsma & Molenaar (1987). The Mokken Scale analysis was repeated for raw and dichotomised item responses, and also by subgroups to investigate sensitivity to changes in population structure by age, housing type, and household composition.

ADL responses were dichotomised as dependent (if the elderly person was receiving human or technological help or did not perform the ADL) or independent, involving minimal loss of information. As noted already, bathing was the ADL in which more people were dependent. Preliminary crosstabulations revealed substantial numbers of elderly people who were independent in bathing, but dependent in mobility (1981, n=77; 1988, n=64). A possible explanation is the inclusion of stripwash as an allowable alternative to bathing in both surveys. When bathing is omitted, crosstabulations of responses to the remaining five items provide evidence of an internally consistent scale, with ADL ordered by increasing severity of disability from mobility, in which more people have help, through transfer to and from a chair, transfer to and from bed, and dressing to eating, with which very few people have help (Figures 4Di and 4Dii). Responses conforming to this hierarchy amounted to 79% of all those dependent in at least one ADL in 1981, and 74% of all those dependent in at least one ADL in 1988.

The structure of the responses on the five item scale formed by the items of getting to and from the toilet, mobility, bed, chair and dressing, and on a six item scale, formed by the addition of bathing, was examined using Mokken Scale Analysis (Table 4Di). Both scales satisfy Mokken's criteria for internal consistency, with H greater than 0.5, and no item scalability less than 0.3, and the ADL order is unchanged between surveys. There was however some indication that scalability in the 1981 survey is improved when the item of bathing is omitted. Because consistency of bathing with the other items was questioned in both Mokken and Principal Components analyses, and because of the difficulties of interpretation raised by inclusion of stripwash, bathing was considered separately in subsequent analyses.

Subgroup analyses were carried out to establish robustness of the hierarchical properties of the five-item scale (Table 4Diii and 4Div). Basic ADL should be less sensitive to culture and environment than IADL, but nevertheless, it was hypothesised that willingness to give and receive help might vary by gender, producing systematic variation in responses for those activities (dressing and eating) where help was mostly human. Dressing and eating did indeed have lower item scalability in the analyses by gender, but the coefficients were still acceptable, suggesting that effects of gender bias are negligible. Dressing also scaled less well when the analysis was confined to people living alone, to investigate whether the hierarchy was sensitive to availability of help. Only two people at each survey had help with eating but lived alone, so scalability of eating amongst this subgroup cannot be assessed. Finally, no material change in item scalabilities was observed when the analyses were repeated by subgroups with and without inside stairs at their home, confirming that assessment of mobility in these surveys was not confounded with use of stairs.

In conclusion, the Mokken scale analysis supports an ordinal hierarchical scale for basic ADL, with dependency in mobility about the house, transfer to and from a chair, transfer to and from bed, dressing, and eating as thresholds for successively increasing degrees of dependency. Transfers to and from a chair and bed, and dressing all index dependency at a similar level of severity of limitation.

Appendix 4D:

Table 4Di) Scalability coefficients for dependency scales by survey

	1981 Item Scalability (n=1123)			1988 Item Scalability (n=1498)		
Activity	Mean[1]	Item Scalability (6 items)	Item Scalability (5 items)	Mean	Item Scalability (6 items)	Item Scalability (5 items)
Bathing	0.36	0.53	-	0.33	0.72	-
Mobility	0.19	0.69	0.84	0.17	0.72	0.79
Chair	0.10	0.71	0.77	0.06	0.68	0.67
Bed	0.07	0.72	0.76	0.04	0.77	0.76
Dressing	0.06	0.66	0.64	0.06	0.66	0.61
Eating	0.01	0.70	0.66	0.01	0.73	0.71
Scalability		0.66	0.75		0.71	0.70
Reliability		0.79	0.87		0.78	0.78

[1] Score 1 for respondents receiving human or technological help with the activity, 0 otherwise

Table 4Dii) Scalability coefficients for dependency scales by gender and survey

	1981 Item Scalability (n=1123)				1988 Item Scalability (n=1498)			
	Men (n=368)		Women (n=755)		Men (men=522)		Women (n=976)	
Item	Mean	Item Scalability	Mean	Item Scalability	Mean	Item Scalability	Mean	Item Scalability
Mobility	0.14	0.75	0.21	0.88	0.15	0.72	0.19	0.84
Chair	0.08	0.70	0.12	0.80	0.05	0.76	0.06	0.62
Bed	0.05	0.72	0.08	0.77	0.04	0.78	0.04	0.75
Dressing	0.06	0.51	0.06	0.70	0.08	0.72	0.05	0.53
Eating	0.01	0.55	0.02	0.69	0.02	0.78	0.00	0.45
Scalability		0.66		0.78		0.75		0.68
Reliability		0.82		0.87		0.81		0.76

Table 4Diii) Scalability coefficients for dependency scales by type of housing and survey

	1981 Item Scalability				1988 Item Scalability			
Type of Housing	With inside stairs (n=619)		No inside stairs (n=471)		With inside stairs (men=902)		No inside stairs (n=592)	
Item	Mean	Item Scalability	Mean	Item Scalability	Mean	Item Scalability	Mean	Item Scalability
Mobility	0.17	0.86	0.21	0.82	0.15	0.73	0.21	0.80
Chair	0.09	0.77	0.12	0.78	0.05	0.69	0.06	0.65
Bed	0.06	0.76	0.08	0.75	0.04	0.80	0.05	0.71
Dressing	0.06	0.65	0.07	0.62	0.07	0.67	0.05	0.50
Eating	0.01	0.75	0.01	0.49	0.01	0.73	0.01	0.63
Scalability		0.76		0.74		0.73		0.75
Reliability		0.87		0.87		0.80		0.83

Table 4Div) Scalability coefficients for dependency scales by gender and living arrangements

	1981 Item Scalability				1988 Item Scalability			
Living Arrangements	Lives alone (n=509)		Lives with others (n=614)		Lives alone (n=739)		Lives with others (n=759)	
Item	Mean	Item Scalability	Mean	Item Scalability	Mean	Item Scalability	Mean	Item Scalability
Mobility	0.19	0.91	0.18	0.81	0.19	0.86	0.16	0.76
Chair	0.09	0.84	0.11	0.74	0.05	0.61	0.06	0.72
Bed	0.05	0.78	0.09	0.75	0.03	0.72	0.05	0.79
Dressing	0.02	0.55	0.10	0.65	0.03	0.39	0.09	0.73
Eating	0.00	0.31	0.02	0.72	0.00	0.19	0.01	0.80
Scalability		0.79		0.74		0.62		0.75
Reliability		0.82		0.88		0.76		0.83

Figure 4Di: Most frequent combinations of ADL dependency, with percentages; participants interviewed at home who were dependent in at least one ADL, 1981

Number of Dependencies	1	2	3	4	5
Combination of dependencies	Mobility	Mobility Chair	Mobility Chair Bed	Mobility Chair Bed Dressing	Mobility Chair Bed Dressing Eating
(% of disabled population)	(35)	(17)	(12)	(12)	(3)
	Dressing	Mobility Dressing	Mobility Chair Dressing		
	(3)	(3)	(3)		

Notes: i) The base for the percentages is all participants who were dependent in at least one of the five ADL (n=234)

ii) Combinations with less than 3% of the disabled subpopulation are excluded (n=28)

Figure 4Dii: Most frequent combinations of ADL dependency, with percentages; participants interviewed at home who were dependent in at least one ADL, 1988

Number of Dependencies	1	2	3	4	5
Combination of dependencies	Mobility	Mobility Chair	Mobility Chair Bed	Mobility Chair Bed Dressing	Mobility Chair Bed Dressing Eating
(% of disabled population)	(51)	(8)	(5)	(8)	(2)
	Dressing	Mobility Dressing			
	(5)	(10)			

Notes: i) The base for the percentages is all participants who were dependent in at least one of the five ADL (n=293)

ii) Combinations with less than 3% of the disabled subpopulation are excluded (n=31)

Appendix 4E: Calculation of odds ratios and 95% confidence intervals

The age-cohort models have the following form:

$$\ln\left(\frac{p_{ijk}}{1-p_{ijk}}\right) = \mu + \alpha A_i + \gamma C_k$$

where p_{ijk} is the probability of dependency for age i, at survey j and cohort k

A_i is the midpoint age for age group i

C_k is a dummy variable which takes value 1 for cohort k and zero elsewhere

μ is the logodds at baseline (for the reference cohort at age zero)

and let a reference cohort be indexed by k=1

then $\ln\left(\frac{p_{ijk}}{1-p_{ijk}}\right) - \ln\left(\frac{p_{ij1}}{1-p_{ij1}}\right) = \gamma$

$$\Rightarrow \frac{p_{ijk}/1-p_{ijk}}{p_{ijk}/1-p_{ijk}} = e^{\gamma}$$

$\Rightarrow e^{\gamma}$ is the ratio of odds of dependency for cohort k, compared to the reference cohort

An approximate 95% confidence interval for γ is given by $\gamma \pm 1.96se(\gamma)$ where $se(\gamma)$ is the standard error for the parameter estimate γ. Hence an approximate 95% confidence interval for the odds ratio e^{γ} is ($e^{\gamma\text{-}196se(\gamma)}$, $e^{\gamma+1.96se(\gamma)}$).

By a similar argument, e^{α} is the ratio of odds of dependency for at age i+1, compared to the odds at age i.

Appendix 4F: Estimated odds ratios of dependency in Activities of Daily Living, using four-item scale[1]; age-cohort and age-period models for men and women separately, 95% confidence intervals (CI) in parentheses

Model	Covariates	Men OR[2] (95% CI)	Women OR[2] (95% CI)
Age+Cohort+	Cohort IV	1.00	1.00
Household	Cohort III	1.40 (0.81, 2.41)	1.74 (1.15, 2.63)*
Composition	Cohort II	1.13 (0.43, 2.97)	2.73 (1.41, 5.25)*
	Cohort I	1.27 (0.21, 7.42)	5.58 (1.99, 15.60)*
	Lives with others	1.00	1.00
	Lives alone	0.73 (0.43, 1.24)	0.51 (0.37, 0.70)*
	Age (intracohort)	1.10 (1.01, 1.20)*	1.02 (0.96, 1.09)
	X^2	8.6	3.9
	df	6	6
Age+Period+	1981	1.00	1.00
Household	1988	0.87 (0.56, 1.35)	0.58 (0.43, 0.80)*
Composition			
	Lives with others	1.00	1.00
	Lives alone	0.73 (0.43, 1.24)	0.52 (0.37, 0.70)*
	Age (cross-sectional)	1.10 (1.01, 1.20)*	1.11 (1.07, 1.15)*
	X^2	11.0	4.6
	df	8	8

[1] Dependent in at least one of getting in and out of a chair, getting in and out of bed, dressing and eating

[2] Odds ratio of dependence:independence in ADL